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SITUATION ANALYSIS OF THE VIETNAMESE ELECTRICITY SECTOR

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SITUATION ANALYSIS OF THE VIETNAMESE ELECTRICITY SECTOR- A PRE-STUDY

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Abbreviations

Abbreviations	Term
ACT	Avoided-Cost-Tariff
BAU	Business As-Usual
bn	Billion
BUR 1	Initial Biennial Updated Report
CDM	Clean Development Mechanism
EDI	Environmental Democracy Index
EPI	Environmental Performance Index
EVN	Electricity of Viet Nam
FiT	Feed-in tariff
GDP	Gross domestic product
GHG	Greenhouse gas
GW	Gigawatts
INDC	Intended Determined National Contribution
kWh	Kilowatt hours
kWp	Kilowatt-peak
LCOE	Levelized cost of electricity
LULUCF	Land use, land-use change and forestry
MAIFI	Momentary Average Interruption Frequency Index
MW	Megawatts
MWp	Megawatt-peak
MWh	Megawatt hours
NAMAs	National Appropriate Mitigation Actions
NGO	Non-governmental organisation
NCCS	National Climate Change Strategy
OECD	Organisation for Economic Co-operation and Development

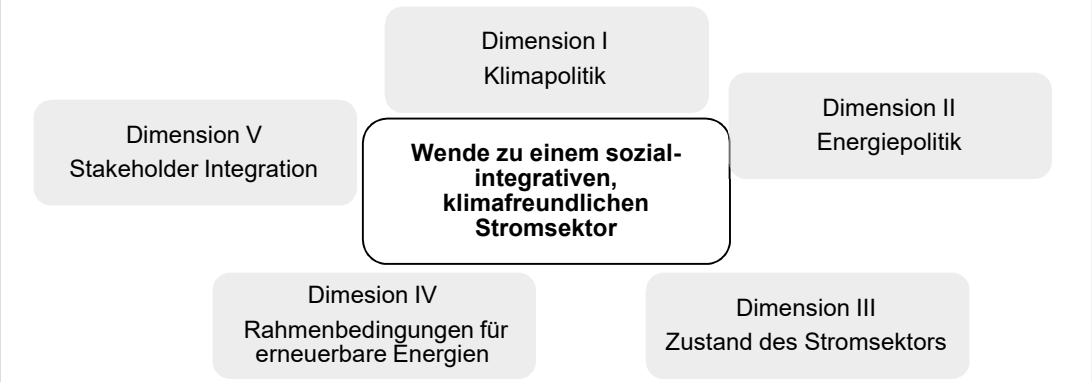
PDP	Power Development Plan
PVN	Petro Viet Nam/ Viet Nam Oil and Gas Group
RE	Renewable energies
RE-DS	Renewable Energy Development Strategy
RISE	Readiness for Investment in Sustainable Energy
RPS	Renewable energy portfolio standard
SAIDI	System average interruption duration index
SAIFI	System Average Interruption Frequency Index
tCO_2	Tonnes carbon dioxide
TWh	Terawatt hours
UNFCCC	United Nations Framework Convention on Climate Change
VGGS	Vietnamese Green Growth Strategy
VNEEP	Viet Nam Energy Efficiency Program
WRI	World Resources Institute

1 Deutsche Kurzfassung

Im Pariser Klimavertrag 2015 wurde beschlossen, dass die globale Klimaneutralität in der zweiten Hälfte des 21. Jhd. erreicht werden soll. Ein Eckpfeiler davon ist die weltweite Dekarbonisierung des Stromsektors. Die Studie "Situation Analysis of the Vietnamese Electricity Sector" gibt einen Überblick über die notwendigen Rahmenbedingungen für die Umsetzung Erneuerbare Energien in sogenannten Entwicklungs- und Schwellenländern.

Dafür bewertet die vorliegende Studie mit Hilfe einer Reihe von Indikatoren, inwieweit Vietnam für eine solche Transformation bereit ist. Die Analyse konzentriert sich dabei auf den Stromsektor. Sie basiert auf 31 Indikatoren bestehend aus 59 Fragen und Unterfragen. Die Indikatoren untersuchen die Rahmenbedingungen in fünf Dimensionen: (1) Klimapolitik, (2) Energiepolitik, (3) Zustand des Stromsektors, (4) Rahmenbedingungen für erneuerbare Energien und (5) Stakeholder Integration.

Abbildung 1: Analytische Dimensionen einer nachhaltigen Transformation des Energiesektors



Quelle: Eigene Darstellung

Als Datengrundlage dienten Studien zum vietnamesischen Stromsektor, THG-Emissionsinventare, Szenarien, Gesetze und politische Grundsatzpapiere, Jahresberichte und Forschungspapiere. Prinzipiell ist die auf Englisch verfügbare Datenlage zum vietnamesischen Energiesektor begrenzt. Quellen, Berechnungen sowie Grafiken und Datentabellen sind in der Langfassung des Berichts aufgeführt.

Die im Rahmen der Studie entwickelten Indikatoren wurden als einfache Ja / Nein-Fragen formuliert, wobei "nein" einer negativen Bewertung und "ja" einer positiven Bewertung des Übergangs zu einem nachhaltigen Stromsektor entspricht. Für eine Reihe von Indikatoren wurden internationale Indizes und andere global-vergleichbare Datenquellen als Benchmark verwendet. Die Langfassung Enthält die Bewertungen im Detail und dokumentiert die verwendeten Quellen.

1.1 Dimension I: Klimapolitik

Dimension I analysiert die Vietnamesische Klimapolitik. Die Betrachtung dieser Dimension ist von Bedeutung, da Klimaschutz häufig einen Haupttreiber für Politikmaßnahmen im Bereich erneuerbare Energien (EE) darstellt. Die Dimension wird von fünf Indikatoren beschrieben: (1) THG-Emissionsentwicklung, (2) Nutzung von CDM- und NAMA Mechanismen, (3) Existenz von Emissionsreduktionszielen, (4) Stärke der Emissionsreduktionsziele, (5) Aktionsplan zur Umsetzung der Ziele, auf die im Folgenden eingegangen wird.

Vietnam befindet sich auf einem emissionsintensiven Entwicklungspfad bei dem im Business-as-usual (BAU) die durchschnittlichen Pro-Kopf-Emissionen über den heutigen globalen Durchschnitt steigen. Emissionsdaten und BAU-Szenarien für Vietnam wurden im Rahmen der Berichte an die UNFCCC (NC 1, NC 2, BUR 1, INDC) erstellt. Vietnams THG-Emissionen betrugen im Jahr 2010 246 $MtCO_2e$ (einschließlich LULUCF) und die Pro-Kopf-Emission beliefen sich auf 2,8 t CO_2e. Die tatsächliche Emissionsentwicklung in 2010 übertraf die Annahmen früherer BAU-Szenarien. Die verschiedenen offiziellen BAU-Szenarien korrigierten die zukünftigen Emissionsannahmen jeweils nach oben. Alle BAU-Szenarien haben gemein, dass sie von weiter stark steigenden Emissionen insbesondere aus dem Energiesektor ausgehen. Eine nachhaltige Entwicklung im Sinne eines frühzeitigen Emissionspeaks würde Gegenmaßnahmen erfordern.

Die vietnamesische Regierung zeigt sich in den National Communications an die UNFCCC besorgt über den Klimawandel und hat die Bereitschaft zum Ausdruck gebracht Emissionen zu reduzieren und Emissionsreduktionsziele formuliert. Der Vietnamesischen grünen Wachstumsstrategie (Vietnamese Green Growth Strategy-VGGS) aus dem Jahr 2012 zufolge können die Emissionen jedoch auch unterhalb des heutigen globalen Durchschnitts gehalten werden. Dieser Strategie zufolge sollen die Emissionen zwischen 2020 bis 2050 um 1,5-2 % / a im Vergleich zum BAU gesenkt werden, was den Anstieg der Emissionen Vietnams auf 391 $MtCO_2e$ 2030 reduzieren würde. Der vietnamesische Klimaschutzbeitrag – die Intended Nationally Determined Contribution (INDC) - der 2015 der UNFCCC kommuniziert wurde, ist demgegenüber konservativer. Er stellt n Aussicht die BAU-Emissionen als eigenständige nationale Anstrengung bis 2030 von 787,4 $MtCO_2e$, um 8 % auf 724 $MtCO_2e$ zu reduzieren.

Die VGGS nennt zwar eine beträchtliche Anzahl an Maßnahmen zur Erreichung der Klimaziele, u.a. die Nutzung von Atomenergie und erneuerbarer Energien, es fehlt hingegen eine konkrete Strategie sowie ein Zeitplan zur Umsetzung.

Vietnam hat überaus erfolgreich den CDM-Mechanismus genutzt, was darauf hinweist, dass prinzipiell die Fähigkeit und Bereitschaft besteht internationale Hilfe für sich in Anspruch zu nehmen.

Zusammenfassend lässt sich für die Dimension I sagen, dass die Diskussionen zu Klimawandel und Green Growth bisher die Energiepolitik noch nicht verbindlich beeinflussen. Ob der revidierte Power Development Plan (PDP) VII, der für das Jahr 2016 erwartet wird den Trend ändert, bleibt abzuwarten.

1.2 Dimension II: Energiepolitik

Dimension II betrachtet die Energiepolitik und wird von folgenden acht Indikatoren beschrieben: (1) politischer Fokus der Energiepolitik, (2) Entwicklung der Stromnachfrage, (3) Ausbau der Erneuerbaren im Vergleich zur Entwicklung der Stromnachfrage , (4) Flexibilisierung der Last, (5) Energieeffizienzziele, (6) Ziele zum Ausbau der erneuerbaren Energien nach Quelle, (7) Netzausbau und (8) der Investitionsbedarf im Stromsektor. Hierzu ergeben sich folgende Ergebnisse:

Im aktuell geltenden PDP VII (2011) waren Klimabedenken noch nicht berücksichtigt. Hier war geplant, den Stromverbrauch im Jahr 2030, zu 56 % aus Kohle, zu 11 % aus Gas und zu 10 % atomar zu decken. Oberste Priorität im PDP VII ist die Deckung der Stromnachfrage, gefolgt von der Versorgungsicherheit und der Qualität der Versorgung. Demgegenüber spielt der Schutz der natürlichen Ressourcen lediglich eine untergeordnete Rolle. Die Auswirkungen des Plans auf die THG-Emissionen bleiben unerwähnt.

Energieexpert_innen gehen davon aus, dass die Pläne des PDP VII bis 2030 mit einer Verzehnfachung der Emissionen einhergehen würden. Es besteht augenscheinlich keine politische Kohärenz zwischen der VGGS, der INDC und dem PDP VII.

Der Ausbau der Erneuerbaren Energieträger im Vergleich zur Entwicklung der Stromnachfrage, stellt sich so dar, dass der Zubau zur Befriedigung der steigenden Nachfrage hauptsächlich fossil und nuklear erfolgen soll, während der Anteil erneuerbarer Energien und großer Wasserkraft langfristig kaum ansteigen soll. Der EE-Anteil - fast ausschließlich aus großer Wasserkraft - lag im Jahr 2015 bei 38 %, bis 2030 soll sich dieser Anteil zunächst bis auf 32 % verringern und sich bis 2050 auf 43 % erhöhen.

In 2016 erfolgt die Revision des PDP VII. Die in 2015 veröffentlichte Erneuerbare-Energien-Entwicklungsstrategie plant für Vietnam einen massiven Anstieg des Stromverbrauchs von 146 TWh in 2014 bis auf 1051 TWh bis 2050. Da die RE-DS lediglich 43 % der Stromerzeugung 2050 abdeckt, müssen 57 % durch fossile und/oder nukleare Ressourcen gedeckt werden. Es wird erwartet, dass der revidierte PDP VII die genaue Zusammensetzung darlegt.

Bisher hat die Regierung keine Maßnahmen erlassen, um die Flexibilität der Energienachfrageseite zu erhöhen. Der Ausbau von Pumpspeicherkapazitäten wurde in der RE-DS im Vergleich zum PDP VII weiter in die Zukunft verschoben: Nach der RE-DS sollen bis 2030 2,400 MW statt wie im PDP VII 5,700 MW installiert sein.

Vietnam hat sich Erneuerbare-Energien-Ziele (einschließlich großer Wasserkraft) gesetzt. In 2050 soll demnach Solarenergie mit 210 TWh die wichtigste EE-Erzeugungsform sein. Biomasse soll 85 TWh bereitstellen, während die Windenergieziele mit 53 TWh bescheiden bleiben.

Die EE-Ziele nach Technologie sind wie folgt:

- Groß- und Kleinwasserkraft: 2015: 56 TWh (34 %), 2020: 90 TWh (34 %), 2030: 96 TWh (17 %),

- Biomasse: 2020: 7,8 TWh (3 %), 2030: 37 TWh (6,3 %) und 2050: 85 TWh (8,1 %),

- Wind: 2020: 2,5 TWh (1 %), 2030: 16 TWh (2,7 %) und 2050: 53 TWh (5 %),

- Solar: 2020: 1,4 TWh (0,5 %), 2030: 35,4 TWh (6 %) und 2050: 210 TWh (20 %).

Den offiziellen Ausbauplänen des PDP VII liegen keine Kostenschätzungen bei. Nach Ansicht von Experten wäre der Plan mit Investitionen in Höhe von USD 50 Mrd. verbunden. Besonders erstaunlich ist das Fehlen einer Kostendiskussion in Bezug auf den Einstieg in die Atomenergie, der für 2024 geplant ist.

Auf Basis dieser Erkenntnisse bleiben die Bedingungen für erneuerbare Energien zweideutig, während EE-Ziele vorhanden sind, die eine grundsätzliche Bereitschaft widerspiegeln, den Sektor zu entwickeln, wird den erneuerbaren Energien nicht zugetraut langfristig die Hauptquelle der Stromlieferung darzustellen. Aktuell sind die Rahmenbedingungen für den Ausbau erneuerbarer Energien in Vietnam nicht ausreichend, die zuletzt vorgelegte Erneuerbare-Energien-Entwicklungsstrategie der Regierung (RE-DS) ist aber ein Anzeichen, dass sich das Investitionsklima in einigen Jahren z.B. durch die Einführung von PV-Einspeisetarifen oder Portfoliostandards verbessern könnte.

1.3 Dimension III: Zustand des Stromsektors

Dimension III untersucht die Situation des Stromsektors mit Hilfe von fünf Indikatoren: (1) Stromemissionsfaktor, (2) Übertragungsnetzverluste, (3) Bewertung nach dem “Getting electricity” Indikator, (4) Strommarktstruktur und (5) Energiesubventionen.

Im Jahr 2014 betrug Vietnams Stromerzeugungskapazität 34 GW. Die einsetzbaren Kapazitäten werden aber mit 23 GW als deutlich niedriger eingeschätzt.

Die Elektrizitätsproduktion im Jahr 2014 betrug 146 TWh dominiert von Wasserkraft (38 %), Erdgas (31 %) und Kohle (26 %). Der Netzstromemissionsfaktor hat durch den hohen Anteil an Wasserkraft aktuell noch eine vergleichsweise niedrige CO_2-Intensität von 0,636 t CO_2 / MWh, diese steigt aber mit zunehmendem fossilen Kraftwerksanteil. Obwohl sich die Stromproduktion zwischen 2005 und um das 3,6-fache erhöht hat, bleibt die Versorgung unzureichend. Insbesondere während Dürreperioden wie etwa im Jahr 2011 kam es in Spitzenlastzeiten zu Ausfällen und Zwangsabschaltungen.

In der Kategorie “getting electricity” des Welt Bank *Doing Business Index* wird die Qualität des Stromversorger Electricity of Viet Nam (EVN) als moderat bewertet. Vietnam rangiert in der oberen Hälfte des Indikators, wenn auch nur an Position 108 von 189.

Die Übertragungsnetzverluste sind mit 9 % im internationalen Vergleich des Weltbank *Development Index* durchschnittlich, liegen aber noch weit höher als in Länder mit hohem Einkommen (Weltbank-Katetegorie: High-Income Countries).

Nur bei der Energieerzeugung sind andere Marktakteure zugelassen. In 2014 produzierte EVN nur noch 43 % des Stroms. Petro Vietnam (PVN) ist mit 13 % Marktanteil das zweitgrößte Energieunternehmen, bereits 22 % der Stromerzeugungskapazität sind in Besitz von unabhängigen Energieunternehmen. Es gibt keinen Endkundenmarkt, hier erfolgt die Versorgung ausschließlich durch EVN. Es gibt keine gesetzliche Regelung zur Stromeigenerzeugung auf Verbraucherseite und folglich auch keine Regelung zur Abnahme von Überschussstrom von Eigenerzeugern.

Öffentlich verfügbare Informationen zur finanziellen Situation von EVN geben kein klares Bild der tatsächlichen Situation. Der durchschnittliche Haushaltstarif beträgt 1622 VND / kWh (~ 0,07 Euro / kWh). Damit liegt er unter den Erzeugungskosten, was kontinuierliche Subventionen an EVN notwendig macht. Die IEA schätzt die Höhe der Energiesubventionen für das Jahr 2010 auf 2,69 Mrd. US-Dollar, das entsprach 2,83 % des BIP. UNDP geht davon aus, dass der durchschnittliche Strompreis auf 8 - 9 USD ct / kWh steigen müsste, um den Sektor nachhaltig zu betreiben. Subventionen erzeugen Fehlanreize für Energieeinsparungen. Stromeigenverbrauchsmodelle bzw. die Direktbelieferung von Endkunden konnten sich bislang auf Grund stark subventionierter Endverbraucherpreise nicht etablieren.

Im PDP VII heißt es, dass die Strompreise durch Marktmechanismen gebildet werden sollen. Die VGGS (2012) kündigte einen Fahrplan zum Ausstieg aus der Subventionierung fossiler Brennstoffe an. Die politischen Entscheidungsträger haben die Problematik von Energiesubventionen erfasst, entsprechende Maßnahmen sind bislang aber ausgeblieben.

Zusammenfassend erschweren das Energiesubventionsniveau und die Monopolstellung von EVN den Eintritt der erneuerbaren Energien in den Vietnamesischen Energiemarkt.

1.4 Dimension IV: Rahmenbedingungen für erneuerbare Energien

Dimension IV nutzt folgende 10 Indikatoren, um die Rahmenbedingungen für erneuerbare Energien zu beschreiben: (1) EE-Potenzialkarten , (2) politische und rechtliche EE-Rahmenbedingungen, (3) EE-Einspeisevorrang, (4) Existenz von Netzcodes, (5) EE-Fördermechanismen (6) Energiepolitik-Monitoring, (7) Zugang zum Endkundenmarkt, (8) EE-Marktgröße und -reife, (9) EE-Finanzierung und (10) EE-Lieferketten. Für diese Indikatoren ergeben sich folgende Ergebnisse:

Die Regierung hat Annahmen zu Wind- und Solarpotenzialen veröffentlicht. Die grundsätzliche Verfügbarkeit von Daten und die Qualität der Karten werden aber von Experten als begrenzt und unzureichend beschrieben.

Kleine Wasserkraft bis 30 MW enthält einen Avoided-Cost-Tarif (ACT), der eine Wirkung entfaltet hat. Die Konstruktion von Staudämmen hat jedoch Auswirkungen auf die lokale Bevölkerung und die Wasserverfügbarkeit für die Landwirtschaft. Vietnam hat Einspeisetarife für Windenergie eingeführt, die allerdings auf Grund ihrer Höhe keine Wirkung entfaltet haben. Die Wirkung des Einspeisetarifs für Biomasse kann noch nicht bewertet werden. Ein Einspeisetarif für Solar ist geplant, aber noch nicht veröffentlicht. Die RE-DS erwähnt zukünftig die Einführung spezifischer Maßnahmen wie die Entwicklung eines Renewable Portfolio Standards, um den EE-Ausbau anzuregen.

Die Datenlage zu erneuerbarer Energieerzeugung, installierten Anlagen und sogar der Ressourcenverfügbarkeit ist nicht gut. Vietnam verfügt nicht über ein öffentliches EE-Anlagenregister. Die Datenlage insbesondere zu Wasserkraftanlagen ist schlecht. Die von EVN veröffentlichten Projektlisten zu Biomasse, Wind und Solar zeigen hingegen, dass in Vietnam bis auf einige Windparks bislang kaum nennenswert Projekte realisiert wurden.

Ansätze für eine EE-Lieferkette, wie bspw. die Produktion von Turbinentürmen, existieren bereits, diese Ansätze könnten sich bei einer nationalen Marktentwicklung zu einem nationalen erneuerbaren-Energien-Sektor ausweiten.

Die Zinssätze von 8.7 % sowie die Kapitalkosten realisierter Windenergieprojekte liegen unterhalb der der Nachbarländer, demensprechend wurden Finanzierungskosten von uns nicht als primärer Hinderungsgrund für eine EE-Entwicklung eingeschätzt.

In den letzten Jahren wurden einige Wasserkraftprojekte realisiert. Eine nennenswerte Entwicklung bei der Installation von Solar- und Wind hat jedoch nicht stattgefunden. Diese Entwicklung ist in Übereinstimmung mit den wenig ambitionierten 2020-EE-Zielen, bei derzeitigem Tempo könnten jedoch selbst diese Ziele verfehlt werden.

1.5 Dimension V: Stakeholder Integration

Dimension V untersucht die Integration verschiedener Stakeholder in den Stromsektor sowie in die Energiepolitik auf Basis von drei Indikatoren: (1) zivilgesellschaftliche Aktivitäten im Energiesektor, (2) Offenheit des Energiesektors für neue Akteure und (3) Bewertung im Environmental Democracy Index.

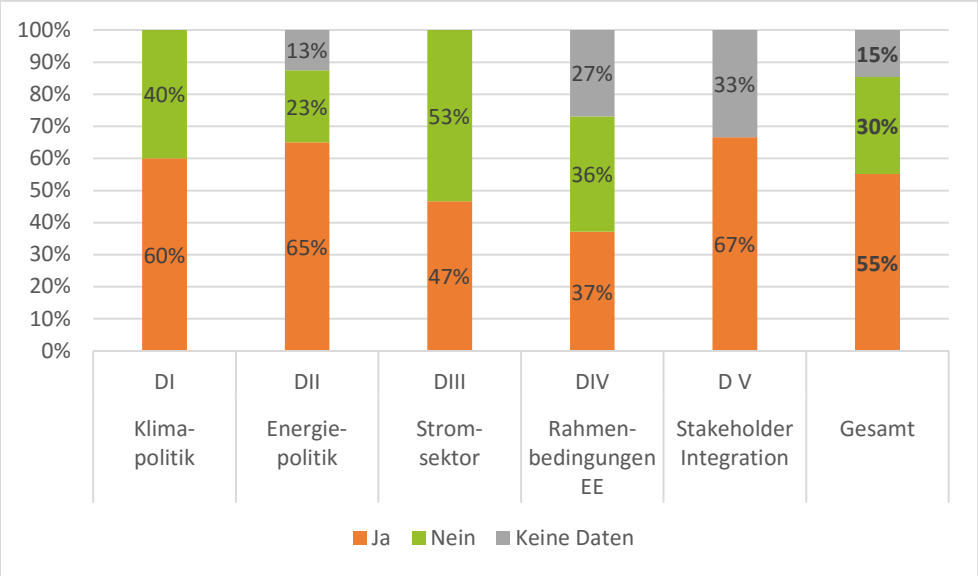
In Vietnam ist ein allgemeines Umweltbewusstsein innerhalb der Zivilgesellschaft vorhanden, aber nur eine begrenzte Anzahl von Organisationen ist speziell im Energiesektor aktiv. Zivilgesellschaftliches Engagement im Energiesektor konzentrierte sich bislang auf die negativen Folgen von Staudammprojekten, es kam auch zu ersten Protesten gegen Kohlekraftwerke durch benachbarte Gemeinden. Projektbeispiele für an das Netz angeschlossene Bürgerenergie, z.B. in Form von Landwirten, die eigene Biomasse-Anlagen betreiben, konnten nicht gefunden werden. Vietnam schneidet beim Environment Democracy Index unterdurchschnittlich ab.

1.6 Zusammenfassung

Unsere Analyse hat gezeigt, dass Vietnam sich Klimaschutzziele gesetzt hat. Die neusten Ziele, die in der INDC vorgelegt wurden, können aber als sehr zurückhaltend beschrieben werden, insbesondere im Vergleich mit dem nationalen Ziel der VGGS. Die Beziehung zwischen der INDC und der VGGS bleibt unklar. Unabhängig davon, welche Ziele anzulegen sind, spiegeln sie sich aktuell nicht in der vietnamesischen Energiepolitik wider. Bis zum Jahr 2050 ist zwar ein erheblicher Ausbau "neuer" erneuerbarer Energien - Sonne, Biomasse und Wind – geplant, tatsächlich sollen diese aber langfristig lediglich ein Drittel zur Stromversorgung beitragen. Das Nachfrageszenario geht von einer extremen Entwicklung aus, was auf eine wenig ambitionierte Effizienzpolitik hindeutet. Die Regierung hat erste vorsichtige Schritte für die Markteinführung erneuerbarer Energien unternommen, aber die aktuellen Bedingungen waren bislang für den Ausbau von neuen EE-Formen unzureichend.

Abbildung 2 fasst die Ergebnisse der Indikatoren in den fünf Dimensionen zusammen.[1] Die Mehrheit der formulierten Indikatoren erhielt eine wenig vorteihafte Bewertung, nur etwa ein Drittel konnte positiv bewertet werden. Die Aussichten auf eine baldige Energiewende in Vietnam sind tendenziell und kurzfristig nicht sehr gut. Langfristig ist ein Ausbau der erneuerbaren Energien geplant, aber kurzfristig sind dafür weder die rechtlichen noch die planerischen Rahmenbedingungen gegeben. An den anderen möglichen Ansatzpunkten nachhaltiger Energiepolitik – z.B. nachfrageseitige Energiepolitik, Einbindung der Zivilgesellschaft und von Community Organizations – wird auf nationaler Ebene nicht gearbeitet.

Abbildung 2: Zusammenfassung der Indikatorenbewertungen



Quelle: Eigene Darstellung

[1] Für die Summe wurde jede Dimension gleichwertig additiert, unabhängig von der Anzahl an Einzelindikatoren in jeder Dimension.

2 Situation Analysis of the Vietnamese Electricity Sector

2.1 Research question and methodology

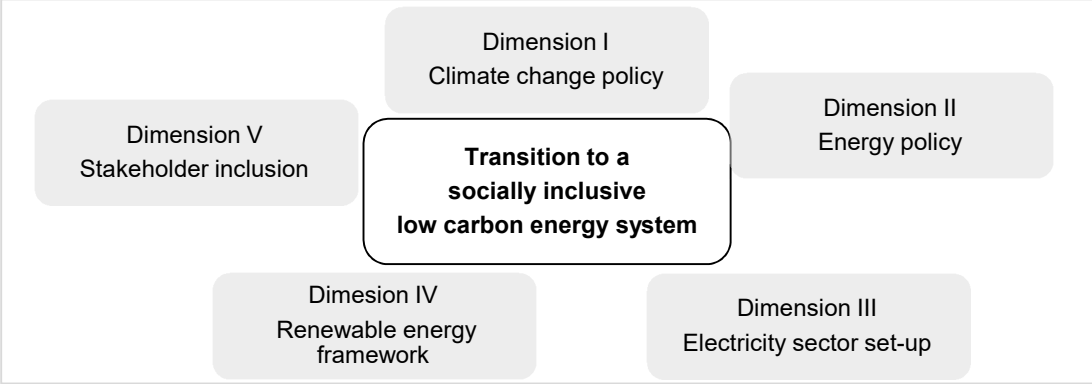
The study at hand gives an overview of the framework conditions for a transition towards a socially inclusive renewable energy based electricity sector in Viet Nam. The Paris Agreement 2015 states that peaking of global emissions has to occur as soon as possible, and that climate neutrality has to be achieved in the second half of the 21st century.

The decarbonisation of the electricity sector is a corner stone for climate neutrality and since key technologies are available already, decarbonisation is much easier than for other emission sources. While allowing economic development and increasing electricity supply - this study considers renewable energy to be the adequate tool to sustainably decarbonize the power sector.

Using a series of indicators, this study assesses the readiness for an energy transition and a low carbon pathway in Viet Nam. Even though the transport and heat sections of the energy sector are relevant for greenhouse gas (GHG) emissions, our analysis concentrates on the enabling environment of the electricity sector.

The study evaluates to what degree Viet Nam is prepared to move towards sustainable energy, and identifies barriers that exist for a start towards an energy transition. The analysis is based on 31 indicators formed by 59 questions and sub questions. The indicators asses the national enabling framework in five dimensions: (1) climate change policy, (2) energy policy, (3) electricity sector set-up, (4) renewable energy framework and (5) stakeholder inclusion (see Figure 1). Indicators track characteristics of the enabling environment of sustainable renewable energy deployment as well as the degree of civil society involvement in energy planning and investment.

Figure 1: Dimensions of the enabling environment of a renewable energy transition



Source: own illustration

Data was collected from a variety of studies on the Vietnamese electricity sector, GHG-inventories, scenarios, legislation on energy and climate change, annual reports and research papers. Sources, calculations as well as graphs and data tables are listed in the annex.

Data for the Vietnamese power sector is scattered over a multitude of sources and a considerable amount of information is only available in the form of ministerial presentations. We could not find analysis of the emission developments related to the power development plans and cost scenarios related to these trajectories. In respect to the costs, the resulting electricity price would be additional useful information. The government does not provide a data base to track its renewable energy expansion. Overall information about installed capacities and their characteristics remain insufficient.

The indicators used in the study at hand where framed as simple yes/no questions where “no” is a negative rating and “yes” a positive one. Table 1 shows the indicators used for each dimension.

Table 1: List of indicators and lead questions

Indicator	Lead question
Dimension I - Climate change policy	
1) GHG-emission trajectory	Will Viet Nam's per capita emissions in the BAU scenario for 2030 stay below the 2012 global average GHG emissions of 6.76 tCO_2 per capita?
2) Existence of GHG-emission reduction targets	Does Viet Nam have binding emission reduction targets?
3) Strength of GHG-emission reduction targets	Does Viet Nam plan to stay below emission levels equivalent to current global average?
4) Number of CDM projects and NAMAs	Is Viet Nam experienced with the use of international emission market and climate financing instruments?
5) Action plan for GHG-mitigation	Does Viet Nam have an action plan to implement climate mitigation targets?
Dimension II - Energy policy	
1) Political focus of energy policy	Does the government consider decarbonisation a main political priority in its energy policy?
2) Future electricity demand	Is per capita electricity production expected stay below 2012 high-income countries average of 9,066 kWh/capita?
3) Trajectory for RE	Is electricity demand expected to be increasingly covered by RE?
4) Load management	Does the government have several policies in place to shift electricity demand?
5) Energy efficiency targets (by sector)	Has the government set energy efficiency targets? Are there sectoral targets?
6) Renewable energy targets by source	Has the government set targets for RE technologies (hydropower/ biomass/wind/solar/geothermal)?
7) Grid expansion	Does the current transmission planning consider renewable energy scale-up?
8) Investment needs in the electricity sector	Has the government estimated power sector investment needs?
Dimension III - Electricity sector set-up	
1) Grid electricity emission factor	Is the grid electricity emission factor below Asia's average grid electricity factor of 990 tCO_2/MWh?
2) Transmission losses in %	Are transmission losses below the global average of 8.1 % (2011)?
3) "Getting electricity" rank	Is Viet Nam's "getting electricity rank" in the upper half of all countries?
4) Electricity market structure	Is the electricity market open to new market actors in the power production sector? In the final consumer sector? In the distribution sector?

Indicator	Lead question
5) Electricity subsidies	Do electricity prices reflect full costs of power generation?
	Is there a commitment to reduce electricity price subsidies?
	Is there an action plan to reduce electricity price subsidies?
Dimension IV - Renewable energy framework	
1) Official atlas on RE potentials	Does the Government publish a high quality and high resolution set of national maps on renewable energy resources for small hydropower, solar, wind, biomass, geothermal?
2) Political and legal framework conditions for RE	Does the country have a renewable energy action plan to implement the targets?
3) Prioritized grid access	Can renewable energy easily access the grid? Is there a prioritized access to the grid for renewable energy?
4) Grid code	Is there a grid code – or specific operational rules – for managing small hydropower, solar, wind, biomass, geothermal?
5) RE-support mechanisms	Do price subsidies or premiums exist to support small hydropower, solar, wind, biomass, geothermal?
	Are price incentives differentiated by size of the installation for small hydropower, solar, wind, biomass, geothermal?
	Do the legal or regulatory frameworks include a formula for price change/adjustment or require regular reviews?
6) Monitoring	Is the government on track regarding installed capacity in accordance with its targets?
7) Final consumer market opportunities	Are grid electricity tariffs for final consumers higher than RE-LCOEs? For which REs?
8) Market maturity	Is the number of projects realized per year > 20 by technology?
9) RE-financing	Can financing be accessed at affordable rates?
10) RE-supply chain	Does Viet Nam produce RE equipment locally?

Indicator	Lead question
Dimension V - Stakeholder inclusion	
1) Civil society activity in the energy sector	Are more than five NGOs predominantly engaged with energy issues?
2) Openness of the energy market	Are natural persons, citizen groups or small farmers active in on-grid new renewable energy?
3) Environmental democracy	Is Viet Nam's Environmental Democracy rank above global average?

BAU: business as-usual, CDM: Clean development mechanism, LCOE: Levelized cost of electricity, NAMAs: National Appropriate Mitigation Actions, NGO: Non-governmental organisation, RE: renewable energy.

Source: own table

The indicators are resulting in "red lights" or "green lights" for energy system sustainability transitions. Several of these indicators require a benchmark to be meaningful. International indices and data basis were used as a means of comparison. Table 2 lists the benchmark data sources used.

Table 2: List of benchmarks for the indicators used

Dimension	No.	indicator	Benchmark	Data sources
D I	1.	GHG-emission trajectory	Global average per capita GHG emissions including Land-Use Change and Forestry in 2012: 6.76 tCO_2e per capita	WRI CAIT Climate Data Explorer
D I	4.	Strength of GHG-emission reduction targets		
D II	2.	Electricity demand	Is per capita electricity production expected stay below 2012 high-income countries average of 9,066 kWh/capita?	Own calculation based on World Bank Development Index Data
D III	1.	Grid electricity emission factor	Asia's average grid electricity factor of average operating margin: 990 tCO_2/MWh	IGES grid electricity emission factors (2015)
D III	2.	Transmission losses	Global average transmission losses 2011: 8.1 %	World Bank Development Index
D III	3.	Getting electricity rank	"Getting electricity rank" in the upper half of 189 ranks	World Bank Doing Business Index
D IV	11.	RE-financing	Lending interest rates in 2014 below 10 %	World Bank Development Index
D V	3.	Environmental democracy	Global average in the Environmental Democracy: 1.42	Environmental Democracy Index

Source: own table

The following section presents the results for the individual dimensions: (1) climate change policy, (2) energy policy framework, (3) electricity sector set-up, (4) renewable energy framework and (5) stakeholder inclusion.

2.2 Results of dimension I: Climate change policy

Dimension I covers climate policy and is described by five indicators. Climate mitigation is a main driver for renewable energy (RE) policy and for policies improving the RE-business environment such as a reduction of fossil fuel subsidies.

Emission data and business as-usual (BAU) -scenarios were published by the Vietnamese government in the 1st National Communication (NC 1) to the UNFCCC in 2003, the 2nd National Communication (NC 2) in 2010 the Initial Biennial Updated Report (BUR 1) in 2014 and the Intended Determined National Contribution (INDC) in 2015.Viet Nam's GHG-emissions in 2010 were 246 $MtCO_2e$ (including LULUCF) and per capita emission were 2,8 t CO_2e. Past BAU-scenarios for 2010 proved to be overly optimistic and were surpassed by emission increases. Official BAU-scenarios for 2020 and 2030 give a wide range of possible developments. In all of these scenarios most emissions result from the energy sector, in the BUR 1 scenario this is even 85 % of future emissions.

The analysis of dimension I highlights that with respect to the GHG-emission trajectory, current scenarios show a significant increase of carbon emissions. Resulting levels will be well above today's global average per capita. A sustainable path would require counteractions.

The Vietnamese government is concerned about climate change and has expressed the willingness to tackle emissions nationally in its National Climate Change Strategy (NCCS, 2011), in the Vietnamese Green Growth Strategy (VGGS, 2012) and in its INDC (2015), and has formulated emission reduction targets. According to the VGGS overall emissions are supposed to be cut without international assistance by 1.5-2 %/a from 2020 until 2050 compared to BAU, which would lead to an increase of Viet Nam's emissions to 391 $MtCO_2e$ by 2030. The internationally communicated pathway by the INDC (2015) is more conservative and states that by 2030 Viet Nam will reduce its BAU-GHG-emissions of 787.4 $MtCO_2e$ by 8 %, which would result in 724 $MtCO_2e$.

The VGGS domestic target would keep emissions below current global averages. Unfortunately, the target was not included in the INDC.

Viet Nam has been successfully applying the tools offered internationally to finance clean development, indicating Viet Nam's capability and willingness of making use of international assistance if offered.

A significant number of planned measures are proposed in the VGGS including nuclear power and RE, but the strategy is lacking precision, concrete time frames and expected results.

Overall climate change has not yet emerged as a key driver of policy making in Viet Nam. The revised PDP VII, awaited for 2016, might change this since the prime minister has announced to stop additional constructions of coal power plants. Table 3 summarizes the results of the indicators for dimension I.

Table 3: Dimension I: Summary of indicator ratings for climate change policy

Indicators of dimension I –climate change policy	Rating
1. GHG-emission trajectory	No ●
2. Existence of GHG-emission reduction targets	Yes ●
3. Strength of GHG-emission reduction targets	No ●
4. CDM projects and NAMAs	Yes ●
5. Action plan for GHG-mitigation	No●

Source: own table

Table 4 lists the indicators, questions and results for dimension I. Figures, sources and calculations are listed in the annex.

Table 4: Results of dimension I: Climate change policy

Indicator	Lead question	Rating	Explanatory note
1) GHG-emission trajectory	Will Viet Nam's rank in average per capita emissions in the BAU by 2030 stay below the 2012 global average of 6.76 tCO_2e?	No ●	GHG-emissions in 2010 were 246 $MtCO_2e$ (including LULUCF) resulting to about 2,8 tCO_2e per capita. In respect to CO_2 only, per capita emissions of Viet Nam were 1.97 $MtCO_2$ in 2011 compared to a global average of 6.76 tCO_2e/capita. The government has presented four official BAU-scenarios. The two available 2010 scenarios where both inaccurate and Viet Nam's emissions were much higher than the expected 141 $MtCO_2e$ to 169 $MtCO_2e$. Actual emissions in 2010 were 246 $MtCO_2e$ (including LULUCF). 2020 scenarios range between 233 $MtCO_2e$ and 447 $MtCO_2e$ and 2030 scenarios offer a range between 516 $MtCO_2e$ and 787 $MtCO_2e$. The 2030 BAU-scenarios of BUR 1 and INDC suggest that Viet Nam reaches per capita emissions levels of 7.43 tCO_2e comparable to todays developed countries.
2) Existence of GHG-emission reduction targets	Does Viet Nam have binding emission reduction target?	Yes●	The government formulated targets in the VGGS, the INDC and the RE-DS. The VGGS targets state that emissions in energy activities shall be reduced by 10 % below BAU by 2020 (20 % with international assistance) and by 20 % below BAU by 2030 (30 % conditional on assistance). The RE-DS changed these targets: GHG-emissions in „various energy activities" shall be reduced by 5 % below BAU until 2020, 25 % below BAU until 2025 and 45 % below BAU for 2050. According to the VGGS overall emissions were supposed to be reduced to 391 $MtCO_2e$ unconditionally and by 1.5-2 %/ a compared to BAU until 2050. The INDC states that by 2030 Viet Nam will reduce its BAU- GHG-emissions of 787.4 $MtCO_2e$ by 8 % which would result in 724 $MtCO_2e$.
3) Strength of GHG-emission reduction targets	Does Viet Nam plan to stay below emission levels equivalent to current global average?	No ●	In the VGGS trajectory emissions would increase but remain below the 2012 global average of 6.76 tCO_2e/capita. The INDC commitment would increase emission levels to around 7 tCO_2e/capita. For the purpose of the rating the INDC communication will be used.
4) CDM projects and NAMAs	Is Viet Nam experienced with the use of emission market instruments?	Yes●	In 2015 Viet Nam was ranked 4th in the world for the number of registered CDM projects, hosting 254 projects of which almost 90 % were energy projects. Viet Nam is preparing the implementation of NAMAs in the waste, steel, cement, chemical fertilizer, wind power and biogas sectors.

Indicator	Lead question	Rating	Explanatory note
5) Action plan for GHG-mitigation	Does Viet Nam have an action plan to implement the targets?	No ●	The VGGS states as possible instruments the establishment of a management system and trading of certified GHG-emissions, carbon taxes, fees and levies, certification and eco-labelling system for green products, and energy efficient equipment and green taxes. Further on it announces a roadmap to phase out subsidies for fossil fuels and a roadmap to initiate green procurement. The mitigation policy instruments are not specified by dates or expected mitigation results, therefore the VGGS is not considered to constitute an action plan.

BAU: Business As-usual, GHG: Greenhouse gas INDC: Intended Determined National Contribution, NAMAs: National Appropriate Mitigation Actions, RE-DS: Renewable Energy Development Strategy, VGGS: Vietnamese Green Growth Strategy

Source: own table

2.3 Results of dimension II: Energy policy

Dimension II covers the energy policy and is described by eight indicators with respective questions.

For dimension II the present conditions for renewable energy are mediocre while the future looks more bright. Climate change concerns were not yet reflected in the 2011 Power Development Plan (PDP) VII. The electricity consumption in 2030 was planned to be covered by coal (56 %), gas (11 %) and nuclear (10 %). The main concern of the PDP VII is to cover the electricity demand, followed by concerns of fuel security and quality of the electricity provided. Protection of natural resources is listed as a 4th objective while emissions are not mentioned in the PDP VII.

Official emission scenarios of the PDP VII are not available but experts claim that if the expansion goes ahead as planned in PDP VII, CO_2-emissions are likely to increase tenfold by 2030 in that case the PDP VII would not correspond to the VGGS. There is no policy coherence between the VGGS, the INDC and the PDP VII. In the government's Renewable Energy Development Strategy (RE-DS, 2015) fossil-fuel and nuclear have a share of 57 % (15-20 % nuclear share) by 2050, the emission consequences remain unclear. The revised PDP VII is expected to clarify how the remaining fossil and nuclear fuel parts will be covered.

In a statement in January 2016 the government announced that future energy plans will follow "international commitments on cutting emissions"and that all plans of coal-fired power plants will be reviewed. Since the INDC includes per capita emissions of 7 tCO_2e, the effect of this commitment on energy policy would need further analysis.

The latest electricity demand scenarios presented in the RE-DS 2015 show consumption levels comparable to the very top of today's national per capita electricity consumers. Viet Nam is expecting a massive increase in electricity consumption from 146 TWh in 2014 to 266 TWh by 2030, 581 TWh by 2040 and 1,051 TWh by 2050.

The basis for these assumptions are not clarified, so it remains unclear whether they are a result of electricity using industrial sectors like aluminium or electric steel or based on innovative models like the electrification of the transport sector.

The power capacity additions are planned to be covered to a large extent by fossil fuels and nuclear. RE will not be expanded disproportionally and the RE-share (including large hydropower) will first decrease from 38 % in 2015 to 32 % in 2030 and then increase again to 43 % in 2050.

The government has put in place an energy efficiency strategy. The Viet Nam energy efficiency program (VNEEP) sets targets for savings of 5-8 % of total national energy consumption compared to BAU levels. The relationship with the power development planning is not clear.

So far the government has not enacted measures to increase the flexibility of the energy demand side. Storage additions - in the form of pump storage - have been postponed.

Viet Nam has set renewable energy targets (including large hydro) with solar power being the most important RE in 2050. These targets are based on the assumption of stalk electricity demand increases. Viet Nam has ambitious 2050 solar (210 TWh) and biomass targets (85 TWh) while its wind power targets remain modest (53 TWh). With respect to the energy demand scenario the share of renewables remains nevertheless mediocre. The targets are as follows:

- Total hydro: 2015: 56 TWh (34 %), 2020: 90 TWh (34 %), 2030: 96 TWh (17 %),
- Biomass: 2020: 7.8 TWh (3 %), 2030: 37 TWh, (6.3 %), and 2050: 85 TWh (8.1 %),
- Wind: 2020: 2.5 TWh (1 % of total electricity production), 2030: 16 TWh (2.7 %), and 2050: 53 TWh (5 %),
- Solar: 2020: 1.4 TWh (0.5 %), 2030: 35.4 TWh (6 %), and 2050: 210 TWh (20 %).

The costs associated with fossil, nuclear or renewable energy expansion plans have not been published. According to experts the PDP VII would require investments of USD 50 bn by 2020. Official cost calculations for the PDP VII are not included in the plan but might be available as an internal document. Particularly astonishing is the lack of a cost discussion regarding the nuclear expansion plans. The first nuclear power plant is expected to go on grid in 2024.

Based on these findings the conditions for renewable energy remain ambiguous, while RE-targets are in place which shows the overall willingness to develop the sector, renewables are not entrusted to be the main form of electricity delivery. A sustainable transformation of the energy sector is currently not planned neither does the government

make a clear connection between its energy development plans and it's climate change targets particularly those listed in the VGGS.

Table 5 shows the result of the indicator rating for dimension II.

Table 5: Dimension II: Summary of indicator ratings for energy policy

Indicators of dimension II - energy policy	**Rating[(1)]**
1) Political focus of energy policy	No ●
2) Electricity demand scenarios	No ●
3) Trajectory for RE	No ●
4) Load management	No ●
5) Energy efficiency targets (by sector)	Yes● No ●
6) Renewable energy targets by source	Yes ● , Yes ● , Yes ● , Yes ● , No ●
7) Grid expansion	[nd]
8) Investment needs in the electricity sector	No ●

[(1)]multiple rating occur if the indicator includes multiple questions [nd] no data obtained or available

Source: own table

Table 6 lists the indicators, questions and results for dimension I. Figures, sources and calculations are listed in the annex.

Table 6: Questions and results for dimension II – energy policy framework

Indicator	Lead Question	Answer	Explanatory note
1) Political focus of energy policy	Does the government state decarbonisation as a main political priority in its energy policy?	No ●	The PDP VII states as its first objective the supply of electricity „in conjunction with the national socio-economic development strategies". As its 4th objective the PDP VII also includes the „development of power along with protection of natural resources, ecological environment and ensuring sustainable development of the country."
2) Electricity demand scenarios	Is per capita electricity production expected stay below 2012 high-income countries average of 9,066 kWh/capita?	No ●	The government has published demand scenarios in the PDP VII and the RE-DS. The latest scenario from the RE-DS reduces near time energy demand scenarios for 2020 from 329 TWh to 266 TWh, and from 695 TWh to 581 TWh in 2030. The assumption for 2050 in the RE-DS - based on own calculations - is a demand of 1,051 TWh. Per capita electricity consumption in this scenario would increase to 9,668 kWh, comparable to today's electricity consumption levels of Korea or Australia.
3) Trajectory for RE	Is increased electricity demand expected to be covered by renewable energy?	No ●	Electricity production in 2014 was dominated by large hydro (2014: 55 TWh/38 %), followed by natural gas (2014: 45 TWh/ 31 %) and coal (2014: 38 TWh/ 26 %). The fossil fuel targets according to PDP VII for 2020 are a 54 % supply by coal, 20 % from hydro and 19 % from gas. 85 % of the emissions expected in the BAU of BUR 1 result from energy production planned. The PDP VII and the Nuclear Power Development Plan state that nuclear shall provide for 10 % of electricity by 2020 and 15-20 % by 2050. According to the RE-DS the total RE-electricity-share is planned to increase only slightly in the long run and to be 38 % by 2020, 32 % by 2030 and 43 % by 2050.
4) Load management	Does the government have several policies in place to shift electricity demand?	No ●	Peak demand varied between 20 GW in 2013 and 22 GW in 2014. Demand curve peaked in 2011 and 2012 at 10:00 and in 2013 at 18:00. Peak demand is expected to increase to 110 GW by 2030. The government has put in place an off-peak-peak differentiated tariff for industrial consumers but no explicit tools to shift demand.
5) Energy efficiency targets (by sector)	Has the government set energy efficiency targets? Are there sectoral targets?	Yes● No ●	The VNEEP targets for savings of 5-8 % of total national energy consumption compared to BAU levels. According to experts, the electricity efficiency targets do not correspond to the energy demand scenarios.

Indicator	Lead Question	Answer	Explanatory note
6) Renewable energy targets by source	Has the government set targets for renewable energy technologies, for		The technologies listed in the RE-DS in order of importance are hydropower, solar, biomass and wind. • The share of hydropower (large and small) is decreasing with the increase of overall production from 34 % in 2020 to 17 % and – based on own calculation – to 10 % in 2050. • The solar targets are: 0.5 % by 2020, 6 % by 2030, 20 % by 2050. • Biomass shall provide for 3 % of electricity by 2020, 6.3 % by 2030 and 8.1 % by 2050.T • The targets for wind are: 1 % by 2020, 2.7 % by 2030 and eventually 5 % by 2050. • There are no targets for geothermal.
	Hydropower?	Yes●	
	Solar?	Yes●	
	Biomass?	Yes●	
	Wind?	Yes●	
	Geothermal?	No ●	
7) Grid expansion	Does the current transmission planning consider renewable energy scale-up?	[nd]	Transmission grids in Viet Nam run on 220 and 500 kV. The investment focus for 2015 is on improving transmission capacity from the north to the south. Wether plans consider RE electricity scale up effects on the grid infrastructure could not be obtained.
8) Investment needs in the electricity sector	Has the government developed an investment cost estimation?	No ●	The government plans are not delivered with a detailed cost analysis but according to experts the PDP VII would require investments of USD 50 bn by2020.

VNEEP- Viet Nam Energy Efficiency Program, BAU-business as usual, BUR 1- Initial Biennial Updated Report, RE-DS- Renewable Energy Development Strategy, PDP VII- Power Development Plan VII

Source: own table

2.4 Results of dimension III: Electricity sector

Dimension III covers the situation of the electricity sector and is described by five indicators, due to a series of sub-questions there are nine ratings for this dimension.

Viet Nam's electricity generation capacity in 2014 was 34 GW. Functional capacities are considered to be far lower at about 23 GW, which would correspond to the 2014 peak demand of 22.2 GW. Electricity production in Viet Nam has increased 3.6 times in the decade between 2005 and 2015. Electricity supply remains insufficient, during drought periods such as 2011 peak demand had to be curtailed regularly.

Electricity production in 2014 was 146 TWh dominated by hydro (38 %), natural gas (31 %) and coal (26 %). The electricity sector set-up from which Viet Nam would need to start transitioning is already comparatively low-carbon due to a large share of hydropower. The grid electricity emission factor of Viet Nam of 0.636 tCO_2/MWh in 2011/2012 is comparatively low, but will increase rather than decrease due to the expansion plans.

The quality and efficiency of the system in place is average by international standards: transmission and distribution losses in 2014 were 9 %, which makes them comparable to global averages but far higher than in high-income countries. Viet Nam therefore shows considerable room for improving the efficiency and thereby sustainability of the energy sector, still a large share of electricity is wasted during transmission.

Service reliability indices in 2014 were a System Average Interruption Duration Index (SAIDI) with 3.134 minutes, System Average Interruption Frequency Index (SAIFI) of 18.1/customer and a Momentary Average Interruption Frequency Index (MAIFI) of 2.63/customer.

EVN provides moderate services to electricity customers as assessed by the "get electricity" indicator of the World Bank. Viet Nam ranks in in the upper half, though only at position 108 of 189.

Regarding its institutional set-up Viet Nam has introduced a competitive generation power market with build–operate–transfer projects and independent power producers. In 2014 Viet Nam was still dominated by Energy of Viet Nam (EVN) producing 43 % of electricity itself. Petro Viet Nam (PVN) is the second largest power company owning 13 % of production capacity. The power production market is opening up and in 2014 22 % of power generation capacity was owned by independent power providers. So far only the public utility EVN is permitted to deliver to consumers directly. There is no legislation in place clarifying how consumers themselves can easily engage in energy provision, e.g. with self-consumption facilities, and how to feed access-energy into the grid.

Energy subsidies in Viet Nam reduce electricity prices under the level of generation costs.

Electricity prices are capped and mostly only increased in accordance with inflation. The IEA estimated overall energy subsidies in 2010 at 2.69 bn USD, equivalent to 2.83 % of GDP in the same year. The average residential tariff was set to be 1,622 VND/kWh (~ 0.07 USD/kWh or~0.07 Euro/kWh). UNDP (2012) considered average electricity price to need to rise to 8-9 USD ct/kWh to allow the sector to operate on a sustainable financial basis.

Electricity subsidies are disincentives for energy savings by consumers and a barrier for possible business cases of renewable energies because they cannot compete in the final consumer market.

The PDP VII 2011 states that it wished to implement electricity prices according to market mechanisms and the VGGS 2012 announced a roadmap to phase out subsidies for fossil fuels. Policy makers have recognized the problems related to energy subsidies but have not reacted accordingly.

The overall set-up of the electricity sector for a development of the renewable energy outside of EVN remains difficult.

Table 7 shows the results of the indicator rating for dimension III.

Table 7: Dimension III: Summary of indicator ratings for electricity sector set-up

Indicators of dimension III – electricity sector set-up –climate change policy	**Rating[(1)]**
1) Grid electricity emission factor	Yes●
2) Transmission losses	No ●
3) "Getting electricity" rank	Yes●
4) Electricity Market Structure	No ● , No ● , Yes●
5) Energy subsidies	No ● , Yes● , No ●

[(1)]multiple rating occur if the indicator includes multiple questions

Source: own table

Table 8 presents the results to the questions formulated for dimension III including explanatory text. Figures, sources and calculations are listed in the annex.

Table 8: Questions and results of dimension III – Electricity sector set-up

Indicator	Lead question	Rating	Explanatory note
1) Grid electricity emission factor	Is the grid electricity emission factor below Asia's average gird electricity factor of 990 tCO_2/MWh?	Yes ●	For 2011-2012 the grid electricity emission factor for average operating power plants in Viet Nam was 0.636 tCO_2/MWh.
2) Transmission losses	Are transmission losses below global average of 8.1 % (2011)?	No ●	Transmission and distribution losses in 2014 were 9 % which is slightly below other lower middle countries but still 3 % points above OECD levels
3) "Getting electricity" rank	Is Viet Nam's "getting electricity rank" in the upper half?	Yes ●	"Getting electricity" tracks the procedures, time and cost required for a business to obtain a permanent electricity connection for a newly constructed warehouse and measures the reliability of power supply and transparency of tariffs and the price of electricity. Viet Nam is ranked 108 of 189 countries.
4) Electricity market structure	Is the electricity market open to new market actors?		Viet Nam has introduced a competitive generation power market with build–operate–transfer projects and independent power producers. In 2014, Viet Nam was still dominated by EVN producing 43 % of electricity itself. PVN is the second largest power company, owning 13 % of production capacity. In 2014, independent power producers owned 22 % of the power generation capacity (14 % owned by locals and 8 % by foreigners).
	For distribution?	No ●	
	For final consumers?	No ●	
	For power production?	Yes ●	
5) Energy subsidies	Do electricity prices reflect production costs fully?	No ●	Electricity prices are capped and mostly only increased in accordance with inflation. Energy subsidies in 2010 was estimated at 2.69 bn USD, equivalent to 2.83 % of GDP in the same year. Average electricity price is considered to need to rise to 8-9 USD ct/kWh to allow the sector to operate on a sustainable financial basis.
	Is there a commitment to reduce electricity subsidies	Yes ●	The PDP VII 2011 states that it wished to implement electricity prices according to the market mechanism. Similarly, the 2011 NCCS announced the establishment of an appropriate energy pricing system that reflect marginal costs by 2015. The VGGS 2012 announces a roadmap to phase out subsidies for fossil fuels. Until 2015 electricity price adjustment to market prices had not occurred.
	Is there an action plan to reduce electricity price subsidies?	No ●	So far the announced roadmap has not been passed.

NCCS-National Climate Change Strategy, PDP VII – Power Development Plan VII, VGGS- Vietnamese Green Growth Strategy

Source: own table

2.5 Results of dimension IV: Renewable energy framework

Dimension IV covers the renewable energy framework and is described by 10 indicators with 24 ratings and 3 questions without rating).

The government has published an atlas on wind and solar potential throughout the country. However, experts have described the quality of the wind atlas and the overall data availability as limited and insufficient.

Hydropower up to 30 MW receives the Avoided-Cost-Tariff (ACT), which has resulted in the construction of a series of projects. Vietnam has already support mechanisms in place, though the feed-in tariff[2] for wind in place is insufficient and has not triggered wind energy development. A feed-in-tariff for biomass is in place, a feed-in-tariff for solar is planned, but not published yet. The RE-DS mentions specific policies such as the introduction of a renewable portfolio standard.

To make a business case of renewable energy self-consumption as well as models delivering to final customers depend on sufficiently high alternative prices of electricity. Direct delivery to final customers face market restrictions and have so far not caught on. For households, consumer prices are below levelized cost of electricity (LCOE) of RE. [3]

There is no monitoring of RE development publicly available and though it can be said that so far no considerable developments in the wind and solar sector has occurred. Data on hydropower projects up to 30 MW and biomass are not available as a concise official report. At least in the field of solar and wind, markets are hardly developed.

A supply chain already exists in Viet Nam and could surely benefit from the market development.

Financial framework conditions in Viet Nam can be considered to not pose a major barrier since the capital expenditure of RE-project is below neighbouring countries.

Overall renewable energy framework conditions have so far led to the development of a series of hydro projects but have not lead to significant developments in solar and wind. This development is in accordance with the very limited RE targets set for 2020, even though at current rates wind targets may not be met.

Table 9 shows the ratings of the indicators in this dimension.

Table 9: Dimension IV: Summary of indicator ratings for the renewable energy framework

Indicators for energy policy	Rating(1)
1) Official atlas on RE potentials	[nd] Yes● Yes● No ● No ●
2) RE- political and legal framework conditions	Yes●
3) Prioritized grid access	[nd]
4) Grid code	Yes ● No ● No ● [nd] No ●
5) RE-support mechanisms	Yes●, No ●, Yes● Yes●, No ●,
5.1) Price incentives differentiated	No ●, n/a, No ●, No ●, n/a
5.2) Formula for price change	No ●

[2] The tariff is a combination of a fixed purchase price of USD 0.068/kWh paid by EVN and a USD 0.01/kWh subsidy financed from the Environment Protection Fund.

[3] Residential grid electricity prices show a range of 1230 VND/kWh (~ 0.05 USD/kWh or~0.05 Euro/kWh) for the minimum rural tariff to 2587 VND/kWh (~ 0.12 USD/kWh or~0.11 Euro/kWh) for the highest urban band. Official industrial tariffs range between 869 VND/kWh (~ 0.04 USD/kWh or~0.04 Euro/kWh) for >110 kV off-peak to 2735 VND/kWh (~ 0.12 USD/kWh or~0.11 Euro/kWh) for 6 kV peak.

Indicators for energy policy	Rating[1]
5.3.) Length of project procedures	No ●
6) Monitoring	[nd]
7) Final consumer market opportunities	No ●
8) Market maturity	No ●
9) RE-financing	Yes●
10) RE-supply chain	Yes●

[1] multiple rating occur if the indicator includes multiple questions, [nd] - no data obtained or available

Source: own table

Table 10 lists indicators, questions and explanatory text, while figures, sources and calculations are presented in the annex.

Table 10: Questions and results for dimension IV: Renewable energy framework conditions

Indicator	Lead Question	Rating	Explanatory note
4) Official atlas on RE-potentials	Does the government publish a high quality validated national atlas on renewable resources potential for		
	Small hydropower?	[nd]	Detailed studies have been undertaken on wind potentials and solar potentials.
	Solar?	Yes●	Estimations exist for all relevant RE potentials which are solar, wind, small hydro, biomass/gas and geothermal. Four studies on wind potentials have been conducted, but data remain inaccurate and not easily accessible.
	Wind?	Yes●	
	Biomass?	No ●	
	Geothermal?	No ●	
5) RE-political and legal framework conditions	Does the country have a renewable energy action plan to implement the targets?	Yes●	The RE-DS announces the introduction of a Renewable Portfolio Standard for power producers of 3 % in 2020, 10 % in 2030 and 20 % in 2050. The RPS for distributors is 5 % in 2020, 10 % in 2020 and 20 % in 2050. It is worth noting that large hydropower of up to 30 MW fall under the definition of renewables.
6) Prioritized grid access	Is there a prioritized access to the grid for renewable energy?	[nd]	No data obtained or available.
7) Grid code	Is there a grid code – or specific operational rules – for managing variable renewable energy?		
	Small hydro?	Yes●	By 2015, there was no official wind nor a solar grid code for Viet Nam.
	Solar?	No ●	
	Wind?	No ●	
	Biomass?	unclear	
	Geothermal?	No ●	

Indicator	Lead Question	Rating	Explanatory note
8) RE-support mechanisms	Do price subsidies or premiums exist to support renewable energy generation?		• Small hydropower receives the ACT which was about 5 USD ct/ kWh in 2015. • There is no FiT for solar. • Wind receives a feed-in-tarff (FiT) of about USD 0.087/kWh since 2011. • Biomass-fueled combined heat and power projects receive a FiT of VND 1,220/kWh (USD 0.07/kWh). Solid waste receive a FiT of VND 2,114/kWh (USD 0.1/kWh). Landfill gas power projects receive a FiT of VND 1,532 (USD 0.07)/kWh • There is no FiT for geothermal.
	Small hydro?	Yes●	
	Solar ?	No ●	
	Wind?	Yes●	
	Biomass ?	Yes●	
	Geothermal?	No ●	
	Are price incentives differentiated by size or area		So far FiT are the same irrespective of size or area.
	Small hydropower?	No ●	
	Solar ?	n/a	
	Wind?	No ●	
	Biomass ?	No ●	
	Geothermal?	n/a	
	Do the legal or regulatory frameworks include a formula for price change/adjustment?	No ●	The legislation does not include a formula for automatic price adjustments.
	Can procedures to start a RE projects >1 MW be finalized within less than 6 months?	No ●	Starting a large RE project is still associated with considerable difficulties and involves national ministries, procedural times for wind projects are reported to take longer than 6 months.

Indicator	Lead Question	Rating	Explanatory note
9) Monitoring	Is the government on track regarding installed capacity in accordance with its targets?	Unclear	So far no publicly available assessment has been carried out tracking the government's performance. Reports on completed and grid connected RE projects and their respective electricity delivery are not available. Small hydropower capacity is currently slightly below 2,000 MW and shall be 3,100 MW by 2020. Wind power development is currently at about 54 MW while the 2020 target is 1 GW. Since a 5 GW of projects are claimed to be waiting for policy improvements, it is too early to say whether the governments might still meet the target.
10) Final consumer market opportunities	Are grid electricity tariffs in the residential sector above RE-LCOEs?	No ●	Residential grid electricity prices show a range of 1,230 VND/kWh (~0.05 USD/kWh or~0.05 Euro/kWh) for the minimum rural tariff to 2,587 VND/kWh (~ 0.12 USD/kWh or ~0.11 Euro/kWh) for the highest urban band. The average tariff was set to be 1,622 VND/kWh (~ 0.07 USD/kWh or ~0.07 Euro/kWh). Official industrial tariffs range between 869 VND/kWh (~ 0.04 USD/kWh or~0.04 Euro/kWh) for >110 kV off-peak to 2735 VND/kWh (~ 0.12 USD/kWh or~0.11 Euro/kWh) for 6 kV peak. Wind LCOE is estimated to be 125 to 270 USD/MWh with an average of 168 USD/MWh. Solar LCOE is estimated to be ranging between 148 to360 USD/MWh with an average of 210 USD/MWh.
11) Market maturity	Is the number of projects realize per year > 10 by technology?	No ●	Small hydro projects are put in place, whilst wind power projects have largely remained in the planning stage. By 2015 three wind farms (3-20 turbines) were installed, though one source claims that only one farm was connected to the grid. Several larger individual wind turbines are installed throughout the country as well as about 1,000 micro-turbines. About 3.6 MWp off-grid solar projects are installed throughout Viet Nam. At least 8 projects exist of a size between 12-210 kWp.
12) RE-financing	Are lending interest rates below 10 %?	Yes●	The lending rates as reported by the World Bank for Viet Nam were at 8.7 % in 2014. The capital expenditure for an onshore wind project is lower than for other projects in the region.

Indicator	Lead Question	Rating	Explanatory note
13) RE-supply chain	Does Viet Nam produce RE equipment locally?	Yes●	Viet Nam has solar production facilities and a handful of wind tower manufacturers. Generator equipment is imported. No information is available in respect to employment data in the supply industry.

FiT-Feed in tariff, LCOE- Levelized cost of electricity, RE-DS- Renewable Energy Development Strategy, RPS- Renewable energy portfolio standard

Source: own table

2.6 Results of dimension V: Stakeholder inclusion

Dimension V is covered by three indicators.

There is generally an environmental consciousness among civil society but still only a limited number of organisations are specifically active in the field of renewable energy. Most civil society movements have been active around the negative consequences of hydro dam projects also first protests against coal power plans by neighbouring communities have occurred. The Vietnamese policy system remains very centralized. Information on community-based, on-grid renewable energy projects e.g. in the form of farmers running their own biomass plants or PV-school projects, could not be obtained. Vietnam ranks below average in the Environmental Democracy Index.

Table 11: Questions and results for dimension V: Stakeholder Inclusion

Indicator	Lead question	Rating	
1) Civil society activity in the energy sector	Are more than five NGOs predominantly engaged with energy issues?	No ●	A few organisations like GreenID member of the Vietnam Sustainable Energy Alliance and INGOs like WWF are working on energy issues. The number is very low though.
2) Openness of the energy market	Are natural persons, cooperatives or small farmers active in on-grid new renewable energy?	[n.d.]	In the course of our research we could not find groups of natural persons or individuals who have installed on-grid applications, particularly in the field of small hydro or biomass such examples could exist though.
3) Environmental democracy	What is Viet Nam environmental democracy rank above global average?	No ●	Viet Nam ranks with 1.16 points below the average score of 1.42.

Source: own table

3 Summary

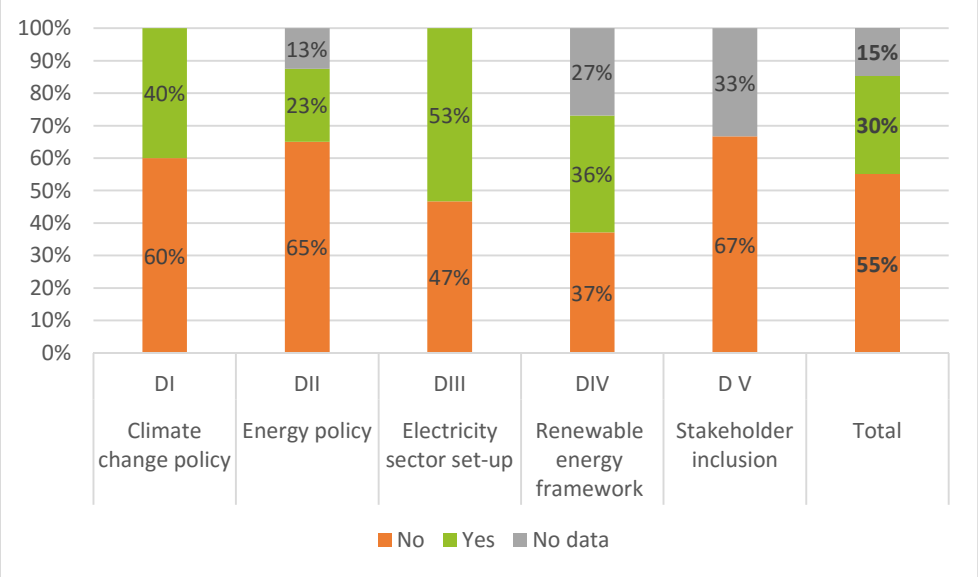
Our analysis has shown that Viet Nam has set a series of climate change targets and brought forward policy papers. The latest target to be achieved with domestic funds communicated in form of the INDC can be described as very cautious, in particular compared with the earlier domestic target in the VGGS which has proposed considerable domestic mitigation efforts. The relationship between both targets remains unclear – potentially the INDC was underrepresenting the real intentions as it might be interpreted as an internationally binding target. A graver concern is that we were unable to match objectives from the energy policy with climate policy, and the difference is not communicated.

In 2050, “new” renewable energy forms - solar, biomass and wind - are expected to contribute to about one third to Viet Nam’s power supply. The demand scenario underlying future energy planning is assuming a rather extreme development. Policy papers do not include explanations or data supporting these results.

First steps have been taken by the government to establish framework conditions for renewable energy deployment such as a series of feed-in-tariffs, but current conditions e.g. for wind energy are insufficient to trigger a significant development. The legal framework in place has not been reviewed and adjusted and therefore remained without effect. Capacity additions of small hydropower take place, but these cannot compensate for the lack of development in the wind sector. Solar incentives did not exist in the past.

Figure 2 summarizes the rankings for each dimension. The total is based on an equal rating of every dimension. The majority of questions formulated for this study received a negative answer, with almost one third of the answers being positive and one fifth remaining unanswered for the time being.

Figure 2: Summary of indicator ratings



Source: own illustration

A conclusion that can be drawn from this assessment is, that at the current stage Viet Nam has embraced the idea that new renewable energy technologies can contribute to the energy systems but has not put in place an effective framework to pursue their development. RE are considered to grow more important in the future but not at the current point of Viet Nam's development.

4 References

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5. Annex: Data Annex of the Situation Analysis of the Vietnamese Electricity Sector"

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Abbreviations

Abbreviations	Term
ACT	Avoided-Cost-Tariff
ADB	Asian development bank
GIC/AHK	Auslandshandelskammer
APEC	Asia-Pacific Economic Cooperation
BAU	Business-as-usual scenario
Bn	Bn
BOT	build–operate–transfer
BUR	Biennial updated report
CAPEX	Capital expenditure
CCWG	climate Change Working Group
CDM	Clean development mechanism
CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CO_2e	carbon dioxide equivalent
DANIDA	Danish international development agency
DMHCC	Department of Meteorology, Hydrology and Climate Change
DOC	Department of Construction
DOIT	Department of Industry and Trade
DPI	Department of Planning and Investment
EC	European commission
ERAV	Electricity Regulatory Authority of Viet Nam
ETS	Emission Trading Scheme
EVN	Electricity of Viet Nam
EVNCPC	EVN Central power Cooperation
FUAS	Federation of Universities of Applied Sciences i
GDE	General Directorate of Energy
GDP	Gross domestic product
GEF	Global Environment Facility

Abbreviations	Term
GHG	Greenhouse gas
GoV	Government
GW	Gigawatts
GWh	Gigawatthours
HCMC	Ho Chi Minh City
IAEA	International atomic energy agency
ICA-SEA	International Copper Association Southeast Asia
IEA	International energy agency
IFC	International finance corporation
INDC	Intended Nationally Determined Contributions
INGO	International Non-Governmental Organisation
IOE	Viet Nam Institute of Energy
IPP	Independent power producer
JICA	Japan international cooperation agency
KFW	Kreditanstalt für Wiederaufbau ("Reconstruction Credit Institute").
KP	Kyoto Protocol
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatthours
kWp	Kiowatt-peak
LCOE	Levelized cost of electricity
LRMC	Long Run Marginal Cost
LULUCF	Land use, land-use change and forestry
M	Million
MAIFI	Momentary Average Interruption Frequency Index
MOF	Ministry of Natural Resources and Environment
MOIT	Ministry of Industry and Trade
MoNRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology

Abbreviations	Term
MPI	Ministry of Investment and Planning
MRV	Monitoring and Reporting and verification system
MW	Megawatt
Mwe	Megawatt electric
MWh	Megawatthours
MWp	Megawatt-peak
NAMA	National Appropriate Mitigation Actions
NC	National communitcation
NCCS	National climate change strategy
NP-DP	Nuclear Power Development Plan
ntp-rcc	National Target Program to Respond to Climate Change
OECD	Organisation for Economic Co-operation and Development
PC	People's committee
PDP	Power development plan
PMR	Partnership for Market Readiness
PV	Photovoltaic
PVN	Petro Viet Nam/ Viet Nam Oil and Gas Group
PWh	Petawatthour
RE	Renewable energy
RED	Renewable Energy Department
RE-DS	Renewable Energy Development Strategy
RISE	Readiness for Investment in Sustainable Energy
SAIDI	System average interruption duration index
SAIFI	System Average Interruption Frequency Index
SE4All	Sustainable Energy For All
SOEs	state-owned enterprises
SPPA	Standard-Power-Purchase-Agreements
T	Tonnes

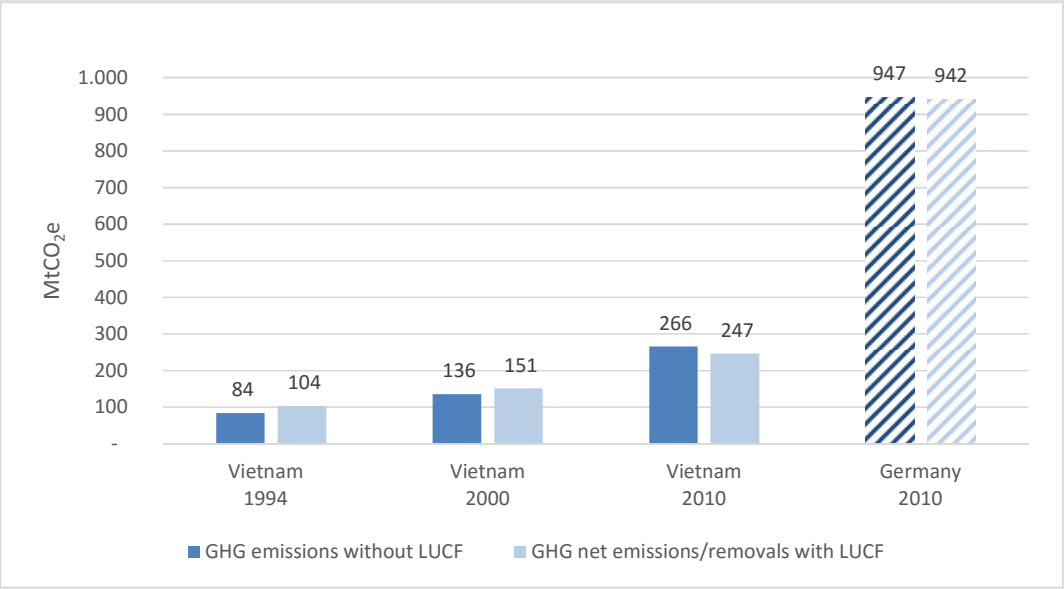
Abbreviations	Term
TWh	Terrawatthours
UNDP	United nations development programme
UNEP	United nations environment programme
UN-ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar
VAEA	Vietnam Atomic Energy Agency
VEESL	Viet Nam Energy Efficiency Standards and Labelling Programme
VGGS	Viet Nam Green Growth Strategy
VND	Vietnamese Dong
VNEEP	Viet Nam Energy Efficiency Program
VNGOs	Vietnamese Non-governmental Organisation
VOSCO	Viet Nam Ocean Shipping Joint Stock Company
VRN	Viet Nam River Network
WB	World bank
WNA	World Nuclear Association

A-1 Data presentation of dimension I: Climate change

A-1.1 Indicator D I-1: GHG-emission trajectory

The Vietnamese government has handed in three communications to the UNFCCC: the 1st National Communication (NC 1) in 2003, the 2nd National Communication (NC 2) in 2010 and the Initial Biennial Updated Report (BUR1) in 2014. GHG-inventories are available for 1994 –(NC 1), for 2000 (NC 2)and for 2010 (BUR 1) (see Figure A- 1). Viet Nam reported for 2010 266 $MtCO_2e$ without LULUCF and 247 with LULUCF, resulting in about 2,8 tCO_2e per capita. Only considering the CO_2-emssions, per capita emissions of Viet Nam were 1.97 $MtCO_2$ in 2011 compared to a 2012 global average 6.76 tCO_2e per capita (WRI, n.d.).

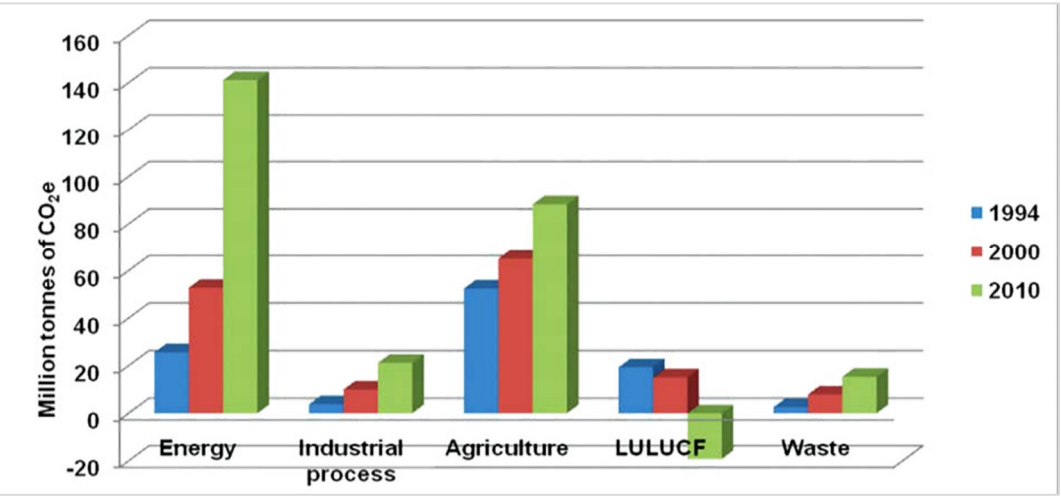
Figure A- 1: Emissions summary for Viet Nam and Germany in comparison



Source: own graph based on UNFCCC (n.d.), UBA (2014)

Between 1994 (GHG-inventory in NC1) and 2010 (GHG-inventory in BUR 1) Viet Nam has experienced a 315 % increase in GHG-emissions. Emissions from the energy sector have increased particularly dramatically (see Figure A- 22).

Figure A- 2: Comparison of GHG-emissions/removals between 1994 and 2010

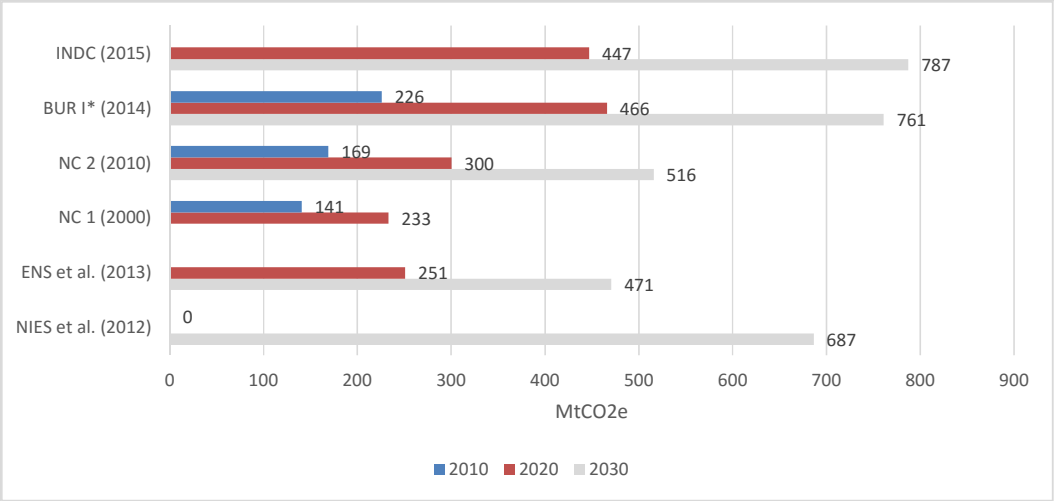


Source: DMHCC/CliTech (2015)

Business as usual projections

The NC 1 formulated the first official Business-as-usual (BAU-) scenario for 2020 and NC 2 the first scenario until 2030. The BUR I communication (2014) thereafter presented a steeply increased BAU-scenario compared to NC 2. Viet Nam's INDC (2015) again formulated a revised BAU-scenario. The two available 2010 scenarios where both inaccurate and Viet Nam's emissions were much higher than the expected 141-169 $MtCO_2e$. Actual emissions in 2010 were 246 $MtCO_2e$ (including LULUCF). The 2030 scenarios suggest that Viet Nam reaches per capita emissions levels of 7.43 tCO_2e comparable to todays developed countries. The official scenarios differ for 2020 between 233 $MtCO_2e$ in NC 1 and 447 $MtCO_2e$ in the INDC. The 2030 scenarios offer a range between 516 and 787 $MtCO_2e$. Figure A- 3 compares the official BAU-scenarios with independent scenarios published by NIES et al (2012) and ENS et al. (2013).

Figure A- 3: Comparison of several business-as-usual scenarios for Viet Nam

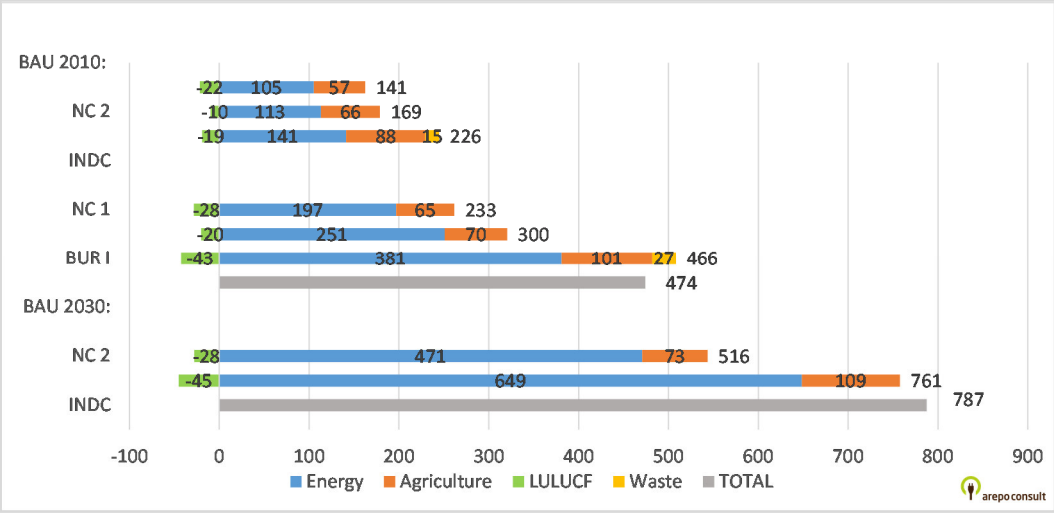


** The BAU-scenario of BUR 1 does not include industrial process emissions.*

Source: own illustration based on NC 1, NC 2, BUR 1(2014), INDC (2015) NIES et al. (2012) and ENS et al. (2013)

As shown in Figure A- 4 emissions from the energy sector are responsible for most emissions, in the course of the formulation of the three scenarios NC 1, NC 2 and BUR 1 the share from the energy sector is increasing each time, as is the total of emissions expected.

Figure A- 4: Comparison of NC 1, NC 2, BUR 1 and INDC BAU-scenarios by emission source

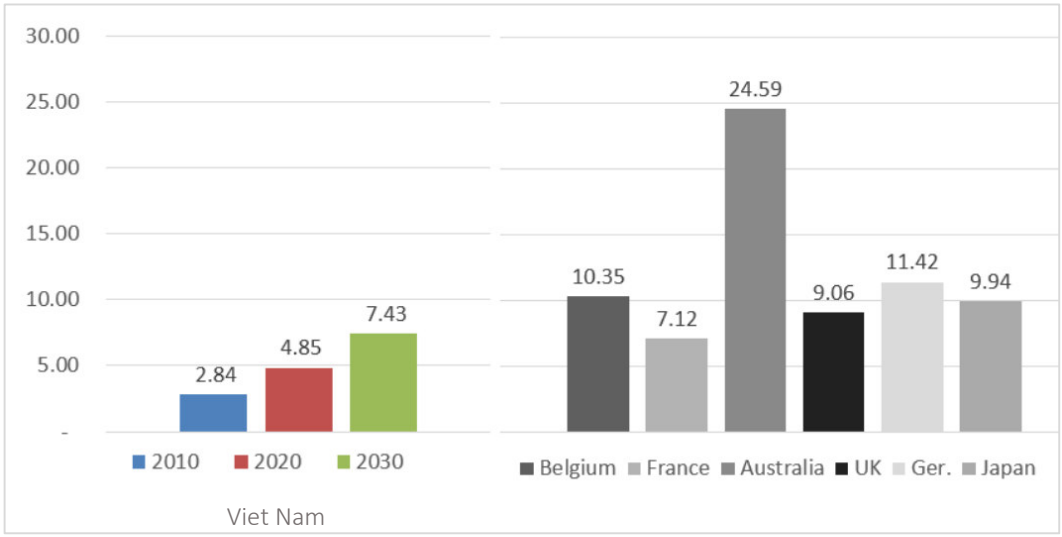


Source: own illustration based on NC1, NC 2, BUR 1(2014), INDC (2015)

In BUR 1 Viet Nam put forward a BAU-scenario that projects an increase of emissions by around 340 % compared to 2010 levels. In this scenario, total GHG-emissions would be increasing beyond 2012 emissions of countries like Australia or the UK (see Figure A- 5) Per capita emissions in the BAU-scenario of BUR 1

(Figure A- 5) would reach 7.43 tCO_2e/capita remaining below many of today's industrialized countries but passing French per capita emissions.

Figure A- 5: GHG-emissions per capita, in Viet Nam in 2010 (incl. LULUCF & industrial processes) and BAU projections of BUR 1[Left], compared to developed countries in 2012 (incl. LULUCF) [Right], in tCO_2e/ capita.



Source: Meessen et al (2015)

Environmental Performance Indicator

The Environmental Performance Indicator (2014)[1] covers Viet Nam. The 2015 edition ranks the country in the midrange as number 81 with 44.5 scores of 178 countries (maximum score of 100). The Vietnamese trend in carbon intensity increase is dramatic and ranks 123 or 178 (3 out of 100 scores). Viet Nam is changing this trend though and this change -the rate at which Viet Nam has slowed down the growth in carbon intensity in the recent past- is ranked at position 42 of 178 (46 of 100 scores) by the EPI.

A-1.2 Climate Change Policy

Viet Nam signed the UNFCCC in 1992 and ratified it in 1994; signed the Kyoto Protocol (KP) in 1998 and ratified it in 2002; set up a National Steering Committee to implement the UNFCCC and KP. It submitted to the UNFCCC Secretariat its Initial National Communication (2003), the Second National Communication (2010), and the Initial Biennial Update Report (BUR 1, 2014) and the Intended Nationally Determined Contributions (INDC, 2015).

Viet Nam does not yet have a monitoring, reporting and verification system (MRV) nor an inventory agency. According to the BUR 1 Viet Nam plans to establish an MRV-system at national and sectoral level "*in the near future*".

A series of legislation states different climate change mitigation targets. These legislations and international commitments are: The National Climate Change Strategy (NCCS) of 2011, the Viet Nam Green Growth Strategy (VGGS) of 2012 and the Intended Nationally Determined Contributions (INDC) of 2015.

Zimmer et al. (2013) describe the NCCS (2011) as "*a turning point in the national political discourse towards a national commitment in mitigation actions signalling Viet Nam's willingness to take responsibility for climate change caused by its own development pathway, shifting from focusing on industrialized countries' sole responsibility for mitigation*."

[1] The EPI is a joint project between the Yale Center for Environmental Law & Policy and the Center for International Earth Science Information Network at Columbia University, in collaboration with the World Economic Forum and with support from the Samuel Family Foundation and the McCall MacBain Foundation.

Content of the National Climate Change Strategy (2011)

- The NCCS mentions adaptation and mitigation actions with equal importance, even though adaptation should be prioritized in the beginning. It lists ten strategic tasks to respond to climate change, among the adaptation measures are reforestation and capacity building. Among the mitigation measures renewable energy, energy efficiency improvements, agriculture and solid waste management are listed.
- Mitigation activities are for the first time formulated unconditionally to international support though the NCCS does not mention any specific emission reduction targets.
- The strategy announces the establishment of an appropriate energy pricing system that reflect marginal costs by 2015.
- The strategy established a National Climate Change Committee (Zimmer et al. 2013).
- The legislation announced the development of an evaluation system of national and international GHG emission reduction activities.

Overall, the basic objectives and political priorities regarding sustainability and climate change of the government of Viet Nam are stated in the VGGS. Its objective is the creation of a "low carbon economy" and "green growth, as a means to achieve a low carbon economy and to enrich natural capital"as "the principal direction in sustainable economic development". The Viet Nam Green Growth Strategy specified the NCCS and introduced the first explicit GHG reduction targets.

Content of the Viet Nam National Green Growth Strategy, Decision No. 1393/QD-TTg, September 2012:

- Combines issues like energy policy, economic policy and climate policy in one comprehensive policy (compare Table 2) demanding all ministries and regional authorities to revise their policies with respect to the principles defined in the Green Growth Strategy.
- Requests all ministries, state agencies and regional authorities to develop Action Plans for its effective implementation
- Envisages a roadmap to phase out subsidies for fossil fuel
- Allocates appropriate funding from the budget to finance its implementation
- Anounces the move towards "trading of certified greenhouse gas emissions, carbon tax and fees and levies" (VGGS 2012, p.12).

Besides the NCCS and the VGGS, Viet Nam has passed a series of legislation with direct climate change importance, these are in particular the National Target Program to Respond to Climate Change (2008), the Environmental Protection Tax law (2010), the law on economical and efficient use of energy (2010), and the VIIth Power Development Plan (PDP VII) (Decision No. 1208/QD-TTg dated July 21, 2011).Table A- 1 sorts these legislative initiatives according to their policy field.

Table A- 1: Climate and energy related policies in Viet Nam

Legal documents	Year	Ministry in Charge	Fiscal Policy	Envir onm. Policy	Climate Policy		Energy Policy	Econom. policy
					Adapt	Mitig.		
Nat. Target Program to Respond to CC	Dec 2008	MoNRE (Nat. Res. &Environ.)						
Law on econ. & efficient use of energy	June 2010 (NA)							
Environmental Protection Tax Law	Nov 2010 (NA) / tax Jan 2012	MoF (Finance)						
Master Plan for Power Developm. VII	July 2011 (PM)	MoIT (Industry and Trade)						
Nat. Climate Change Strategy	Dec 2011 (PM)	MoNRE (Nat. Res. & Environ.)						
Vietnam Green Growth Strategy	Sept 2012 (PM)	MPI (Planning & Investment)						

Source: Zimmer et al. (2013)

A-1.3 Indicators D I-2&3: GHG-emission reduction targets and strength

According to the Viet Nam National Green Growth Strategy, Viet Nam aims to reduce emissions between 2020 and 2030 by 1.5-2 % compared to BAU[2]. In the energy sector emission reductions shall be -10 % until 2020 and – 20 % until 2030 (with an addition of 10 % conditional to international support).

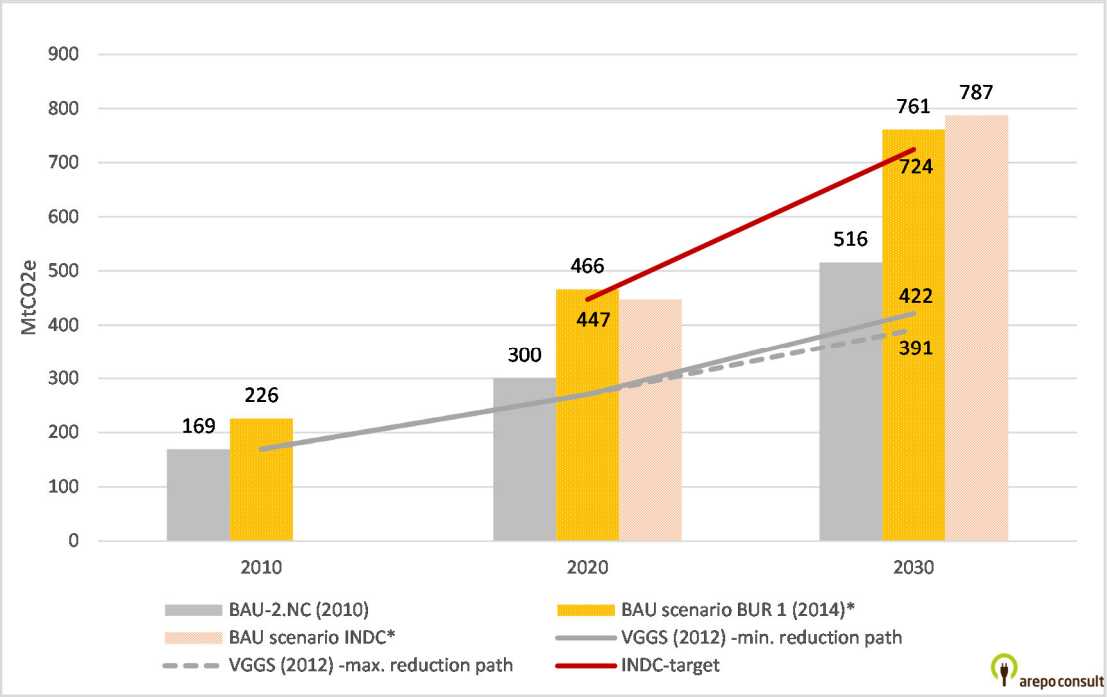
Viet Nam's INDC (2015) sets as a target the reduction of emissions to 8 % below BAU by 2030 and a conditional target of 25 %. ÍNDC refers to a BAU-scenario very similar to the BUR I communication (2014) which is steeply increased compared to the 2nd National Communication BAU-scenario.

Figure A- 6 presents the VGGS reduction plan with the INDC target of 8 %. As can be seen the reduction pathways differ widely. Whilst VGGS (domestic target) would result in per capita emissions of 3.8 t/capita, the INDC domestic targets would reach to emissions of 7.0 t/capita compared to an INDC-BAU-scenario of 7.4 tCO_2e/capita[3]. The targets including international support would result in per capita emissions of 4,4 tCO_2e/capita. For comparison in 2012 global average per capita GHG emissions including Land-Use Change and Forestry were 6.76 tCO_2e per capita (WRI, n.d.).

[2] The VGGS refers to the BAU formulated in the 2nd National Communication to the UNFCCC (compare with Figure A- 5)

[3] Based on a population estimation of 103,117,000 in 2030 (Viet Nam Population Forecast 2009-2049, General Statistics Office, 2011).

Figure A- 6: BAU-scenarios and emission reduction pathways in Vietnamese legislation



** Both BAU-scenarios exclude emissions from industrial processes*

BAU-Business-as-usual scenario. NC- National Communication, VGGS-Viet Nam Green Growth Strategy, INDC – Intended Nationally Determined Contributions

Source: ENS et al. (2013); NIES et al. (2014)

Finally, the Renewable Energy Development Strategy (RE-DS) (2015) states additional reduction targets in various energy activities of 5 % below BAU until 2020, 25 % until 2030 and 45 % until 2050. Table A- 2 summarizes all targets of VGGS, INDC and RE-DS to allow for an easier comparison.

Table A- 2: Summary of the GHG-emission reduction targets of the VGGS, INDC and RE-DS

	Until 2020	Until 2030	Until 2050
Viet Nam National Green Growth Strategy (2012)			
Reduce annual GHG-emissions below BAU		1.5-2 %	1.5-2 %
GHG-intensity (GHG-emissions/ unit of GDP) compared to 2010 levels	8-10 % (20 % conditional*) 1-1.5 %/a		
GHG-emissions from energy activities below BAU	10 % voluntarily (20 % conditional*)	20 % (30 % conditional*)	
Intended Nationally Determined Contributions 2015			
Reduce GHG-emissions compared to BAU		- 8 % (25 % conditional*)	

	Until 2020	Until 2030	Until 2050
Viet Nam's Renewable Energy Development Strategy up to 2030 with an outlook to 2050			
GHG-emission reductions below BAU in various energy activities	5 %	25 %	45 %

** Conditional on additional international support*

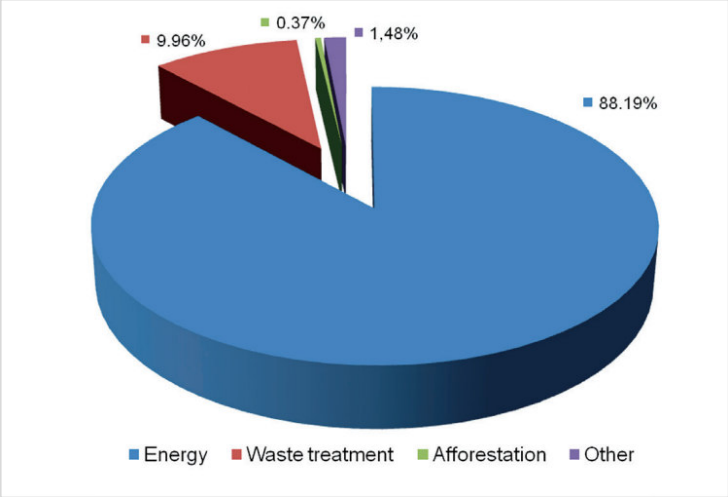
BAU - Business-as-usual scenario

Source: own table based on VGGS 2012, INDC 2015 and RE-DS 2015

A-1.4 Indicator D I-4: CDM projects & NAMAs

In 2015 Viet Nam was ranked 4th in the world for the number of registered projects under the Clean Development Mechanism (CDM). Until 2015, Viet Nam had hosted 254 CDM projects (INDC, 2015). Among the 254 projects, energy projects account for 87.6 %, waste treatment for 10.2 %, reforestation and afforestation for 0.4 % and other projects for 1.8 %.

Figure A- 7: Distribution of Viet Nam's registered CDM projects by sector



Source: BUR 1 (2014)

Viet Nam is preparing the implementation of National Appropriate Mitigation Actions (NAMAs) in the waste, steel, cement, chemical fertilizer, wind power and biogas sectors. As part of its activities under the Partnership for Market Readiness (PMR, n.d.) program, Viet Nam is focusing on the steel and waste sector. The planned MRV system and crediting NAMA shall provide experience for a cap-and-trade program in the steel sector, which could start in 2020.

A-1.5 Emission trading schemes

From 2013 to 2018 the first pilot market based instruments in selected sectors/regions are planned. Based on the experience of the pilot program, a cap and-trade system in the steel sector might be introduced as a stepping-stone towards a domestic emission trading system. The establishment of a domestic carbon market instrument and connection to international market could take place in the period 2018-2020.

A-2 Data presentation of dimension II: Energy policy framework

A-2.1 Indicator D II-1: Political focus of energy policy

The PDP VII states as its first objective the supply of electricity „in conjunction with the national socio-economic development strategies“. As its fourth objective the PDP VII also includes the „development of power along with protection of natural resources, ecological environment and ensuring sustainable development of the country.“

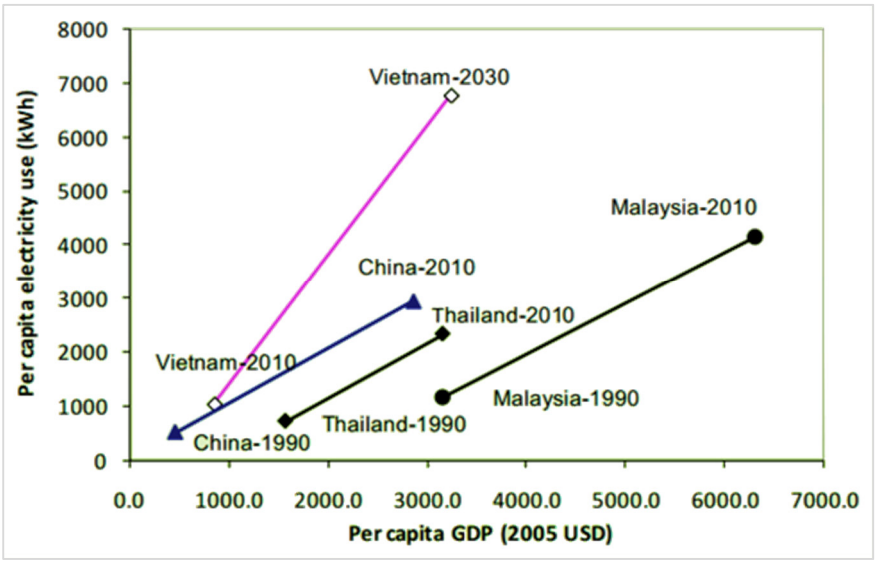
A-2.2 Indicator D II-2: Future electricity demand

Between 2000-2009 for every percentage point increase in growth commercial energy demands increased by more than 1.5 % (SE4all, 2012) with some sectors even recording a two-digit growth in commercial energy consumption (SE4all, 2012).

The PDP VI and PDP VII for 2005-2025 and 2010-2030 respectively envisaged rapidly increasing electrical power demand. Demand was expected to grow at an average annual rate of between 9.9-11.2 % for the 2005-2025 period with annual electricity production increasing from 97.4 TWh in 2009 to 227-305 TWh in 2020, and 695-834 TWh in 2030.

Most analysts seem to agree and expect massive increases in electricity demand of 14 %/a so that demand will have tripled between 2015 and 2025 (Grantham, 2015). Others criticised the PDP VII demand scenario for being unrealistically high which would force too many coal and nuclear capacity expansions into the energy system. Green ID has compared the PDP VII assumption with other countries in the region: The plan expects Viet Nam’s energy intensity to increase from 1,000 kWh / capita to 7,000 kWh/ capita (Figure A-8) which would correspond to the average per capita demand of Germany (Wold Bank, 2015i).

Figure A- 8: Viet Nam’s power consumption per capita according to PDP VII in comparison with other countries in the region



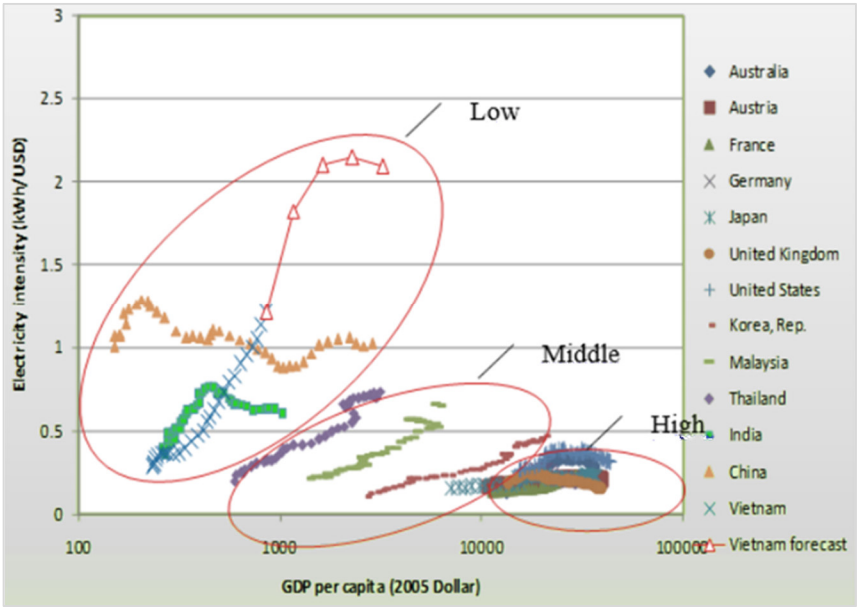
Source: Green ID (2015)

Whilst in 2012 per capita electricity demand in Vietnam was 1,273 kWh/capita (Wold Bank, 2015b), the RE-DS assumes a power demand in 2050 of 1,051 TWh. Per capita electricity consumption in this scenario

would increase to 9,700 kWh[4], comparable to today's electricity consumption levels of New Zealand (9,373 kWh/capita) or Korea (10,346 kWh/capita).

Green ID also presented the PDP VII energy intensity by GDP compared to other countries (Figure A- 9). The electricity intensity per unit of GDP would increase to levels above 2 kWh/USD, higher than even in electricity intensive economies like Thailand (below 1 kWh/USD) or China (around 1 kWh/USD).

Figure A- 9: Energy intensity by GDP per capita of nation groups in the world



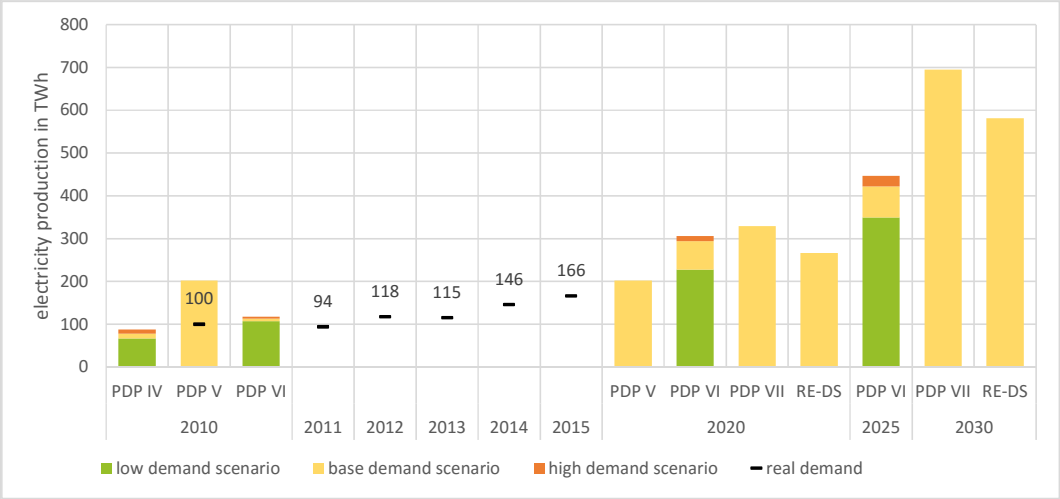
Source: Green ID (2015)

Viet Nam's power demand growth slowed down due to lower economic growth rates than originally expected. The country's demand for electricity is around 166 bn kWh in 2015 (RE-DS), compared with 194 bn-210 bn kWh forecast by the government in 2011 (PDP VII). Annual average growth slowed to 5.63 % from 2011 through 2014, compared with 7.26 % in the 2001-2010 period (WSJ, 2015).

The Renewable Development Strategy has reduced the demand scenarios for the immediate future of 2020 but is assuming an increase of Viet Nam's electricity demand till 2050 to more than 1 PWh. Figure A- 10 compares the power demand scenarios of PDP IV, V, VII and RE-DS with real developments until 2030.

[4] Underlying for the calculation is an population estimation for 2049 of 108,707,000 (General Statistics Office, 2011)

Figure A- 10: Electricity production in Power Development Plans IV-VII and the Renewable Development Strategy 2010-2030 compared to real demand



Base and high demand scenarios are presented as stacked beyond the green low demand scenario.

PDP: Power Development Plan, RE-DS: Renewable Development Strategy

Source: own illustration based on VUSTA (2007)

A-2.3 Indicator D II-5: Energy efficiency targets by sector

Viet Nam's National Climate Change Strategy (NCCS, 2011, p.2) stresses the importance of energy efficiency for reducing greenhouse gas emissions. Energy efficiency could be achieved by reducing the energy subsidies (see p.63) as is planned by the Viet Nam Green Growth Strategy.

Viet Nam's economy wide energy efficiency is rather low. Based on purchasing power parity Viet Nam produces a GDP of 560,000 USD per GWh primary energy use whereas Germany is at 910,000 USD. Based on nominal values it is even worse: 230,000 USD (Viet Nam) vs. 1,015,000 USD (Germany). The energy demand scenarios suggested by the government are very high, and energy demand is claimed to increase far above the economic growth rate. According to these scenarios energy efficiency in Viet Nam would decrease by factor 3 (see Table A- 3) until 2030 LEEN GmbH (2015).

Table A- 3: Development of energy demand and GDP in Viet Nam

	Growth rate	2011	2020	2030
GDP [billion USD]	7,5%	122	234	482
Energy demand [TWh]	13%	535	1,607	5,456
GDP per GWh [USD]		230,000	145,000	88,000

Source: LEEN GmbH (2015)

The Viet Nam Energy Efficiency Program (VNEEP) is a ten-year program, which was approved in April 2006 by the Prime Minister. It includes multiple energy efficiency targets including savings of 3 – 5 % during the period 2006 – 2010 (Phase 1e). By 2010, about 4 % of the total energy consumption was saved compared to a business-as-usual (BAU) scenario (LEEN GmbH 2015). For Phase II (2012-2015) the VNEEP targets for savings of 5-8 % of total national energy consumption compared to BAU levels. In order to reach this goal an energy efficiency law was passed in 2011.

Viet Nam currently has no sectoral efficiency targets (APERC 2013).

Table A- 4: Viet Nam energy efficiency targets

	2006	2010	2011	2015	2020	2030
Electricity elasticity coefficient/ GDP		"current": 2		1.5	1.0	
VNEEP energy savings goal (compared to the BAU case)	3-5 %		5–8 %			

Source: PDP VII

A-2.4 Energy capacity development

Future capacity expansion is laid out in the PDP VII (2011) which is expected to be revised in 2016 and in the RE-DS (2015).

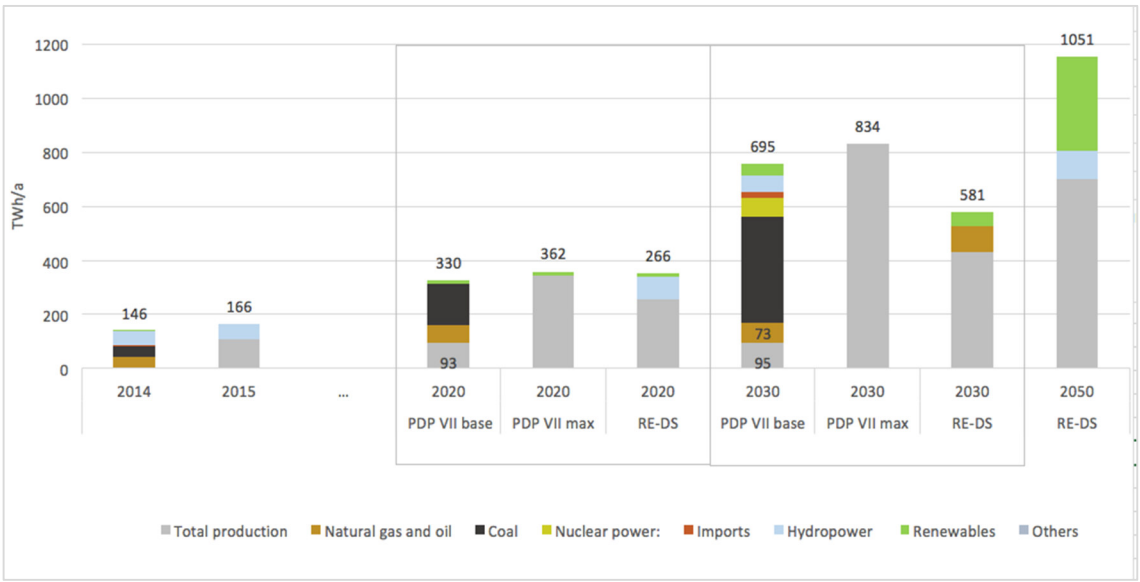
A-2.4.1 Fossil fuel targets

According to the PDP VII, fossil fuel capacity is expanded and most of the capacity additions are planned in the coal sector.

The latest RE-DS reduces energy demand projections by 63 to 96 TWh compared to PDP VII but does not provide new projections for the associated capacity developments. Therefore, in the following we will therefore present the previous PDP VII fossil fuel targets, even though they do not correspond to the RE-DS demand scenario.

Figure A- 11 shows a comparison of PDP VII and RE-DS scenario to the extent that data is available.

Figure A- 11: Comparison of the power production targets of PDP VII and RE-DS by source



Source: Own illustration based on PDP VII and RE-DS

Table A- 5 provides an overview of the most relevant targets. PDP VII proposed a significant expansion of coal power. If the expansion goes ahead as planned in PDP VII, CO_2-emissions are likely to increase tenfold by 2030 (KfW, 2015). Construction work has started on one of the major planned coal plants: Vinh Tan 1 (1,200MW). Five Chinese banks provided a syndicated loan of USD 1.4bn, accounting for 80 % of the total project cost (Bloomberg NEF, 2015).

Table A- 5: Fossil fuel targets according to PDP VII

	2020	2030
Coal production percentage	*46,8 %* [2]	
Gas in MW	10,400 MW	11,300 MW
Production percentage	*24 %* [2]	
In TWh (% of total)	66 TWh (20 %)	73.1 TWh (10.5 %)

Sources: Wold Bank (2015a)

In a statement in January 2016 the government announced that future energy planswill follow "international commitments on cutting emissions"and that all plans of coal-fired power plants will be reviewed (Climate Home, 2016). Since the INDC includes per capita emissions of 7 tCO_2e, the effect of this commitment on energy policy would need further analysis.

A-2.4.2 Nuclear power targets

The development of nuclear power in Viet Nam shall „*ensure stable power supply in the future as the primary sources of domestic energy will be depleted*" (PDPVII 2011) EVN (2015b) states that "*nuclear power development is essential in replacement of thermal power plants using fossil fuels as well as reduction of emissions of greenhouse gases. At the same time, nuclear energy is considered as a solution to meet the power demand of the country in the future."* The Government of Viet Nam considers nuclear energy a green energy technology like solar, wind and tidal energy (VGGS, 2012).

The main drivers behind nuclear energy investment are energy security/import security, growing energy demand and climate change.

The nuclear power development plan (NP-DP) was approved by the government in 2007[5] and set a target of 8 GW of nuclear capacity by 2025. The plan specifies that by 2050, nuclear electricity will account for about 15–20 % of total commercial energy consumption (Grantham, 2015). PDP VII states that the first nuclear power plant in Viet Nam is supposed to enter into operation in 2020 then covering about 10.1 % of electricity production in 2030 (Zimmer et al. 2013). Table A- 6 shows the status of the nuclear plans as of 2015.

Table A- 6: Nuclear Power Capacity Development plans in Viet Nam

	2019	2020	2030
Capacity plan according to Power Master Plan VII		8 GW [1]	
Construction plan as of 2015	Start of construction	2 GW (Ninh Thuan 1)	
Electricity production			70,5 TWh [1]
Share in electricity production		2.1 % [2]	10.1 % [1]

Sources: (1) PDP VII; (2) Wold Bank (2015a)

[5] Decision No. 1855/QD/TTg (2007) Approving the National Energy Development Strategy of Viet Nam for the period up to 2020 with outlook to 2050

There are two nuclear power stations in the construction and concrete planning phase. Calls for a radioactive dumping site have been raised (Tuoitrenews, 2015b), but so far no site has been publicly communicated.

Ninh Thuan 1 nuclear power plant

Russia has agreed to finance and build 2,400 MWe of nuclear capacity in Viet Nam. The first reactor Ninh Thuan 1, with a total capacity of 2,000 megawatts (2x1,000) was bought from Russian nuclear service provider ROSATOM. The plant's location is 340 km east of Ho Chi Minh City in Phuoc Dinh. The reactor is planned to be cooled with sea water and the uranium is imported (IE, 2014). Ninh Thuan 1 has been delayed several times. The original start was planned for 2014, with a scheduled start of operations in 2020. In 2015 the government announced to start construction in 2019 (WSJ, 2015) expecting to complete the plant by 2024 (Tuoitrenews, 2015b).[6]

Ninh Thuan 2 nuclear power plant

Japan has agreed to provide the hardware for the 2000 MWe (2x1,000) Ninh Thuan 2 power station at Vinh Hai.

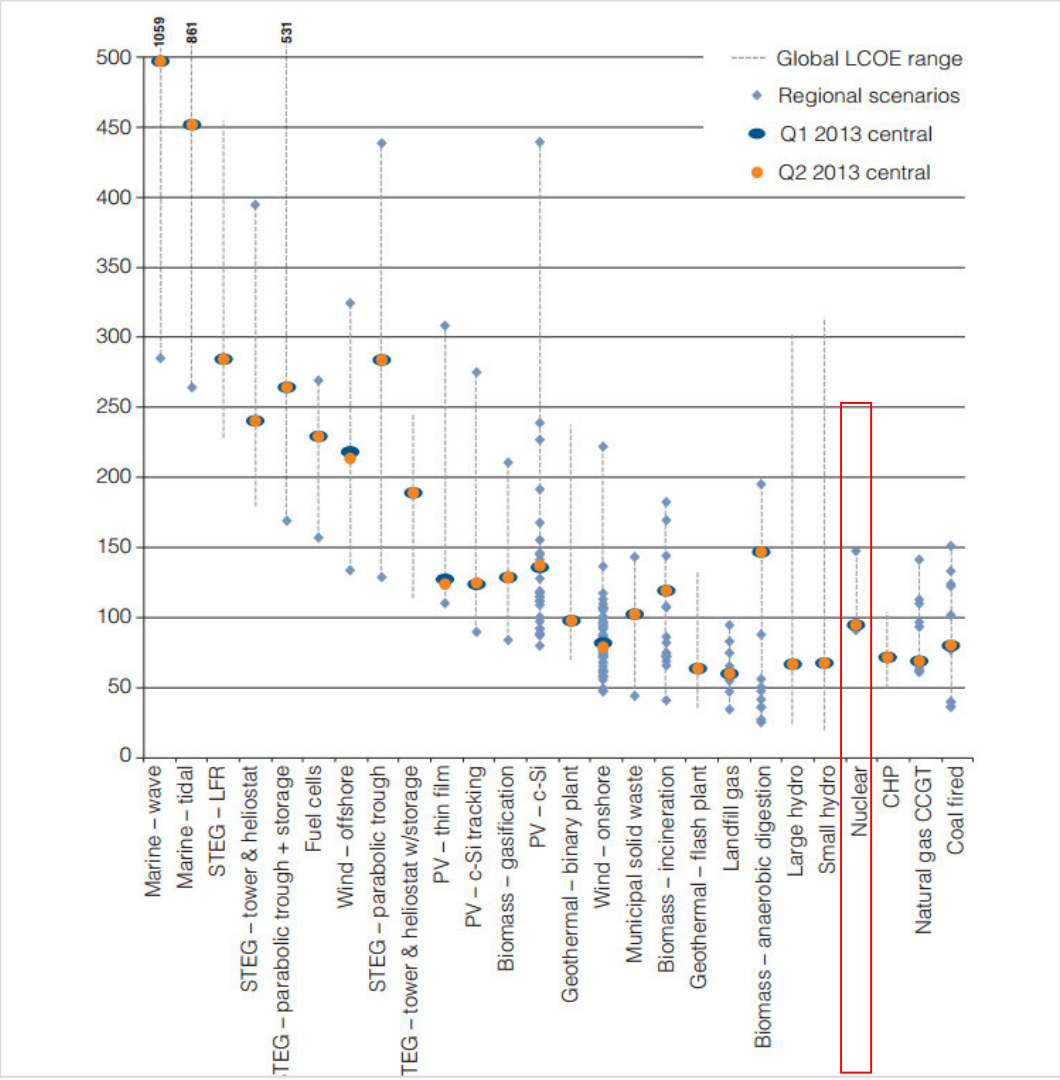
Costs and LCOE of the Ninh Thuan power plants

The construction cost of the two plants, with a total capacity of 4,000 MW a year, was estimated in 2008 at VND200 trillion (USD 9.2 bn) (Tuoitrenews, 2015b). An financing agreement for up to USD 9 bn finance was signed in November 2011 with the Russian government's state export credit bureau, and a second agreement for USD 500 m loan covered the establishment of the Centre for Nuclear Energy Science & Technology jointly by Rosatom and MOST (WNA, 2015).

The Vietnam Atomic Energy Agency (VAEA) project cost assessment assumes that Ninh Thuan 1 is feasible at an electricity price of 7.10 USD ct/kWh in the base scenario and at up to 8.0 USD ct/kWh for sensitivity analysis (VAEA, 2014). This would be considerably below international average LCOE for nuclear which is ranging globally between 9,1 and 147 USD ct/kWh (Bloomberg NEF, 2013n) as shown in Figure A- 12.

[6] EVN in contrast claims that they started construction of Ninh Thuan 1 in 2014 (EVN, 2015b).

Figure A- 12: Global levelized cost of nuclear energy in the second quarter 2013 (USD/MWh)*



*the given range is an average scenario and does not reflect actual maximum and minimum values

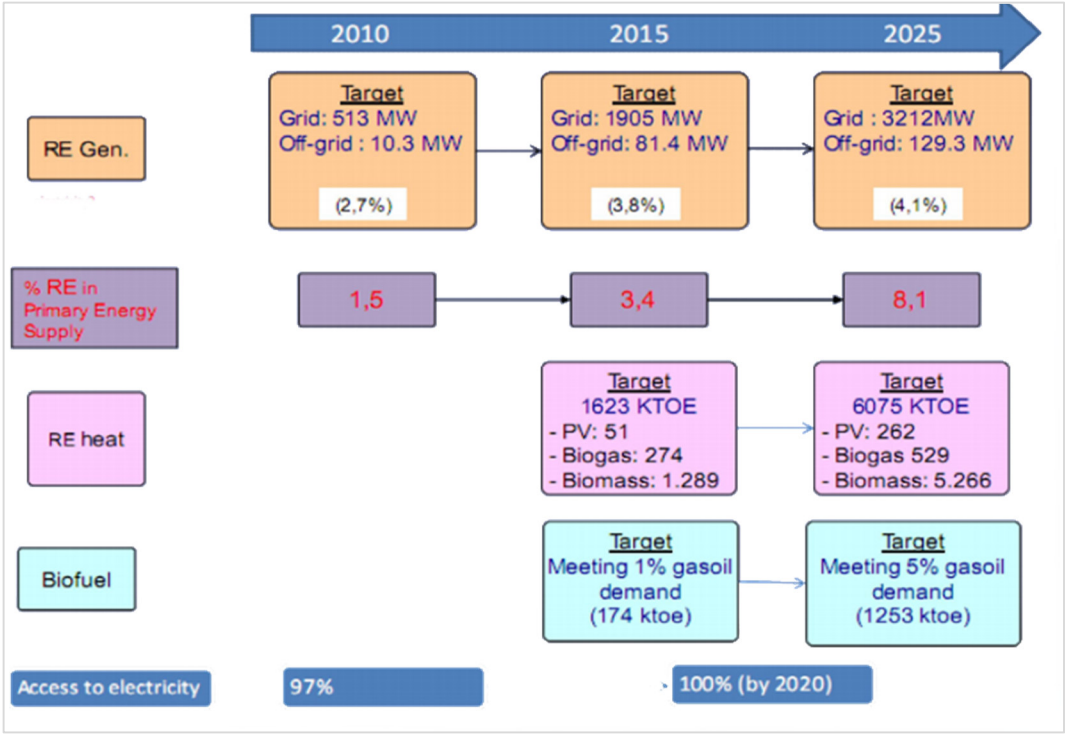
Source: Bloomberg NEF (2013n)

Assuming an employment factor of 16 for construction and 0.33 for operation and maintenance as suggested by Rutovitz et al. (2009), the power plant should offer temporary construction jobs for 38,400 people and offer long-term employment for 372 persons. In the absence of a planned waste disposal site, the employment created at the waste disposal site is not included.

A-2.5 Indicator D II-3 & 6:Renewable energy targets

Viet Nam's RE targets were laid out for the first time in the National Energy Strategy (2007) establishing a 3 % RE target in commercial primary energy by 2010 and of 5 % by 2020. The National Climate Change Strategy 2011 (Decision No: 2139/QD-TTg) sets for the share of renewable energy in total commercial primary energies a target of 5 % for 2020 and of 11 % for 2050 (NCCS, 2011). The first technology specific RE targets were introduced by the Power Plan VII in 2011. According to PDP VII Viet Nam aims to increase the share of electricity generated from renewable resources from 3.5 % of total electricity generation in 2010 to 4.5 % in 2020 and 6 % in 2030. Figure A- 13 lists the key targets.

Figure A- 13: Overview of key renewable energy targets until 2025



Source: MOIT (2013b)

The Vietnamese government has a target for wind power development laid out in PDP VII of 1,000 MW (equivalent to 0.7 % of the total electricity capacity) by 2020 and of about 6,200 MW (2.4 %) by 2030. The target for biomass (co-generation in cane sugar mills) is an aggregate capacity of about 500 MW by 2020,2,000 MW by 2030; corresponding to a production percentage of 0.6 % by 2020 and 1.1 % by 2030. The Governments priority is hydropower, especially projects will multi-purposes: flood control, water supply, power production. The target is an increase of the aggregate capacity of hydropower from 9,200 MW to 17,400 MW by 2020.

The Renewable Energy Development Strategy (RE-DS) 2015 reduced the energy demand scenario of PDP VII by 63-96 TWh. The RE-DS added the first ever targets for solar with a 2050 production target of 210 TWh. The RE-DS increased the previous wind targets of PDP VII slightly and added an additional target for 2050. The wind target of 53 TWh remains far behind the solar targets. In comparison to PDP VII the RE-DS postponed the 2030 pump storage expansion plans from 5.700 MW to 2.400 MW. The RE-DS does not include plans on non-renewable power production or installed capacities.

Table A- 7: Renewable energy targets in the NCCS, PDP VII and the RE-DS

		2010	2011	2014	2015	2020	2030	2050
Power development plan VII, 2011								
Wind	In MW		30[1]			1,000	6,200	
Production percentage	*In %*					*0.7 %*	*2.4 %*	
Electricity production	*In twh*					*2.3*	*16.7*	
Solar	In MW			20				
Biomass	In MW					500	2,000	
Production percentage	*In %*					*0.6 %*	*1.1 %*	
Hydropower	In MW	9,200				17,400	146,800	
Production percentage	*In %*					19,6		
Electricity production according to demand scenario						66-70*		
Pump storage	In MW					1800	5700	
Total new RE capacity	In MW	513				3,212		
RE-production share in electricity produced	*In %*	3.5 %				4.5 %	6.0 %	
Total electricity output (lower range)	In TWh				194	330	695	
National Climate Change Strategy, 201, Decision No. 1885/2007/QD-ttg3								
% RE in total commercial primary energy supply		3 %			3.5 %	4.5 %	11 %	

		2010	2011	2014	2015	2020	2030	2050
Renewable Energy Development Strategy up to 2030 with an outlook to 2050 (2015)								
RE share in total primary energy consumption					31.8 %	31 %	32.3 %	44 %
Total electricity production					166*	266*	581*	*1051**
Total hydropower	In TWh				56	90	96	*104**
Pump storage	MW						2,400	8,000
Wind	In TWh				0.18	2.5	16	53
Production percentage	*In %*					*1 %*	*2,7 %*	*5 %*
Solar	In TWh				0.01	1.4	35.4	210
Production percentage	*In %*					*0.5 %*	*6 %*	*20 %*
Biomass	In TWh				0.6	7.8	37	85
Production percentage	*In %*				*1 %*	*3 %*	*6.3 %*	*8.1 %*
Renewable portfolio standard						3 %	10 %	20 %
Electricity production from RE sources – total	In TWh				58	101	186	452
Production percentage	*In %*				*35 %*	*38 %*	*32 %*	*43 %*

[1] International Copper Association Southeast Asia Ltd (ICASEA) (2014) *** own calculation based on other data provided.***

Source: NCCS 2011, MoIT (2011), RE-DS (2015)

A-2.6 Indicator D II-7: Grid condition and expansion

There are two main lines built as 500 kV circuits from North to South. They have a capacity of 2,300 MW. According to EVN (2015b) further improvements of these transmission capacities are planned for 2015.

A-2.7 Indicator D II-8: Investment in the energy sector

Sectoral representatives assume that PDP VII would require investments of USD 50 bn by 2020 (GIC/AHK, 2015). Media reports state that EVN was expected to mobilize VND 600 trillion (USD 27.51 bn) for the national power grid development alone in 2016-2020 (VietNamNet Bridge, August 2015).

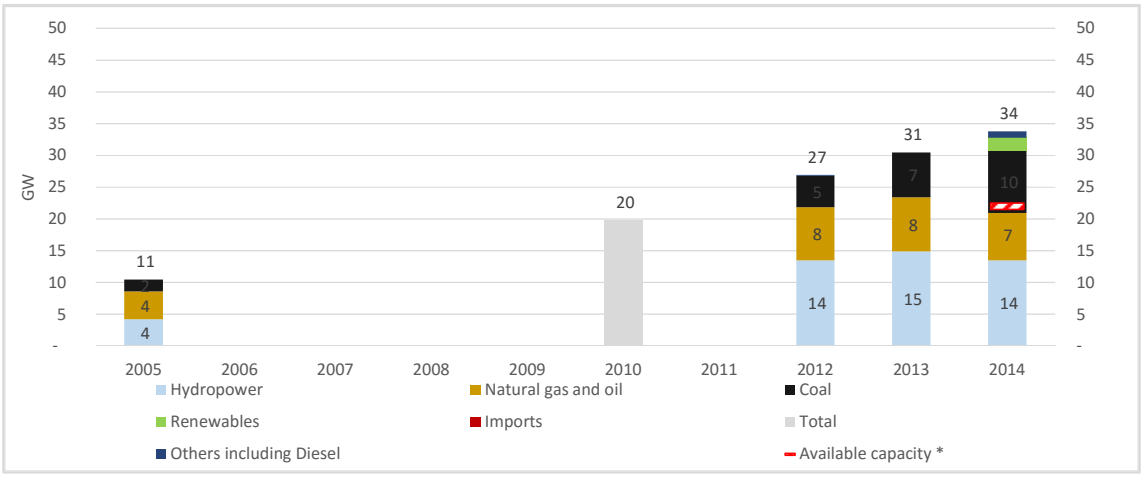
Financing of the energy sector is considered difficult, as donors with Viet Nam having reached lower-middle-income levels will withdraw their support steadily. Energy subsidies make the financial situation of EVN difficult, as EVN is unable to accumulate sufficient investment capital from retained earnings and to pay energy generated by independent power providers (UNDP, 2012).

A-3 Data presentation of dimension III: Electricity sector set-up

A-3.1 Installed capacity

As shown in Figure A- 14 the electricity production capacity installed in Viet Nam in 2012 was 27 GW (EVN, 2013b), by 2014 this had increased to 34 GW (Bloomberg NEF, 2015) (Figure A- 14). Of this capacity 2.3 GW were clean energy technologies such as wind, solar, biomass, small hydro and biofuel technologies. (Bloomberg NEF, 2015).

Figure A- 14: Installed electricity production capacity until 2014 (by source)



** according to the European chamber of commerce*

Source: Nguyen et al. (2008), EVN (2013a), Bloomberg NEF (2015), GIC/AHK 2015

A-3.2 Availability of generation capacity, energy access and security of supply

The European Chamber of Commerce estimates that only about 65 % (21 to 23 GW) of the power production capacity is actually available (GIC/AHK, 2015).

Viet Nam has achieved an electrification rate of 99 % (Wold Bank 2015i). By 1995, roughly half of Viet Nam's population still had no access to electricity. To address this problem, the government set clear nationwide electrification targets the following year. Their implementation brought about rapid

improvements in the power supply, with access to electricity increasing to 93 % of the population by 2004 (ADB, 2015)

Similarly to other countries, e.g. Costa Rica[7], heavily relying on hydropower, Vietnam is facing difficulties meeting electricity demand at the end of the dry season. The availability of hydropower capacities depending on sufficient water especially towards the end of the dry season (October-April). Impacts of prolonged drought such as in 2009/10 were widely felt with widespread power cuts at times of peak demand. Demand shortfalls are expected to continue whilst climate change is causing more exceptionally dry years and additional stresses on hydroelectricity supply (UNDP, 2012). Climate-change induced droughts are already a recognizable impact for Viet Nam (Cruz et al., 2007). The government is well aware of the relationship between climate change and threats to the power supply from hydropower.[8] The EVN annual report regularly states that droughts affect energy production.[9] In the dry season and more so in periods of drought hydropower is causing considerable conflict, since hydropower plants are competing with agriculture for the same water sources (Se4all, 2012; UNDP, 2012). Hydropower is in parts extending the dry season for downstream water users until the reservoirs are filled (GreenID, 2015).

In 2011 EVN asked for VND13 trillion (USD 666.8 m) in additional government funding to operate oil-fuelled thermal plants to overcome a serious power shortage (VietNamNet Bridge 2011). The cut offs cause enterprises to maintain their own generators, raising costs and damaging Viet Nam's competitiveness (UNDP, 2012).

A-3.3 Peak demand and times

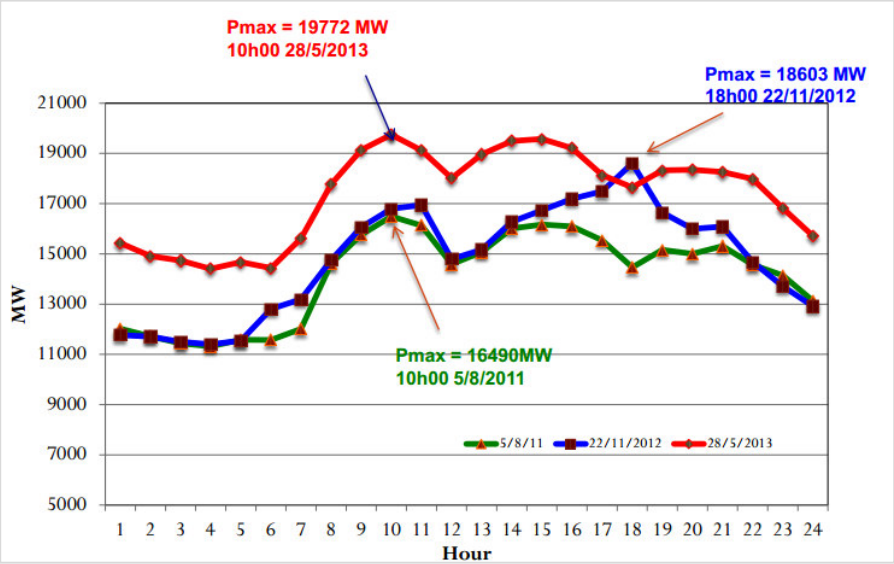
Peak time analysis is helpful to identify suitable efficiency measures, e.g. if peak times are occurring in times of particularly high uses of air-conditioning energy efficiency standards for cooling appliances can be effective to cap such peaks. For daytime peaks solar energy can contribute to peak energy supply. Viet Nam Peak demand in 2014 was 22.2 GW (Eurocham, 2015), 19.8 GW in 2013 EVN (2014) and 21 GW in 2012 (Siemens, 2013). Peak demand is expected to increase to 110 GW by 2030 (Siemens, 2013). Peak demand in the past was occurring during daytime hours (e.g. in May 2013 and August 2011), as well as after sunset as in November 2012 (Figure A- 15).

[7] Costa Rica resorts to electricity rationing and the burning of petroleum to compensate for the reduced hydroelectric generation in the late dry season. THE TICO TIMES News (2014)

[8] The BUR 1 states „as a result of climate change …In the last five years, decreases in the dry season surface water led to water shortages and drought in river basin downstream, hydropower reservoirs and irrigation systems" (BUR, 2014).

[9] For late 2012 and early 2013 EVN reports prolonged drought in Central Viet Nam and the West Highland (EVN, 2013b), in 2014 droughts in effecting the central region of Viet Nam (EVN, 2015).

Figure A- 15: Hourly load curve of the peak day

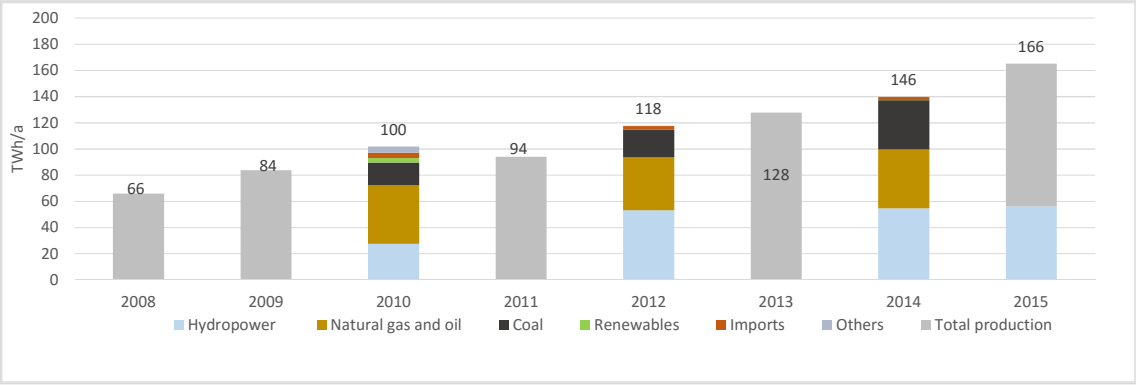


Source: EVN (2013b)

A-3.4 Electricity production

As shown in Figure A- 16 electricity production is dominated by large hydro (2014: 55 TWh/ 38 %), followed by natural gas (2014: 45 TWh/ 31 %) and coal (2014: 38 TWh/ 26 %) (Figure A- 16). Total clean energy production was 5.3 TWh (Bloomberg NEF, 2015)[10].

Figure A- 16: Historic electricity production by source



Source: Hai & Lien (2015), EVN (2012), EVN (2015)

The 2008 grid emissions factor of 0.5764 tCO2/MWh had increased to 0.6244 tCO_2/MWh by 2011 (GEF 2014). For 2011/2012 the average grid electricity emission factor for operating power plants was 0.636 tCO_2/MWh (IGES, 2015) (see Figure A- 17).

[10] Bloomberg NEF (2015) defines new low-carbon emitting clean energy technologies as wind, solar, geothermal, biomass, small hydro and biofuel technologies, but not large hydro and nuclear power.

Figure A- 17: Grid Emission Factor in Viet Nam in t-CO_2/MWh

Combined Margin EF (Average)	Combined Margin EF (Max)	Combined Margin EF (Min)	Operating Margin EF (Average)	Operating Margin EF (Max)	Operating Margin EF (Min)	Build Margin EF (Average)	Build Margin EF (Max)	Build Margin EF (Min)
0,564	0,645	0,496	**0,636**	0,788	0,488	0,491	0,624	0,342

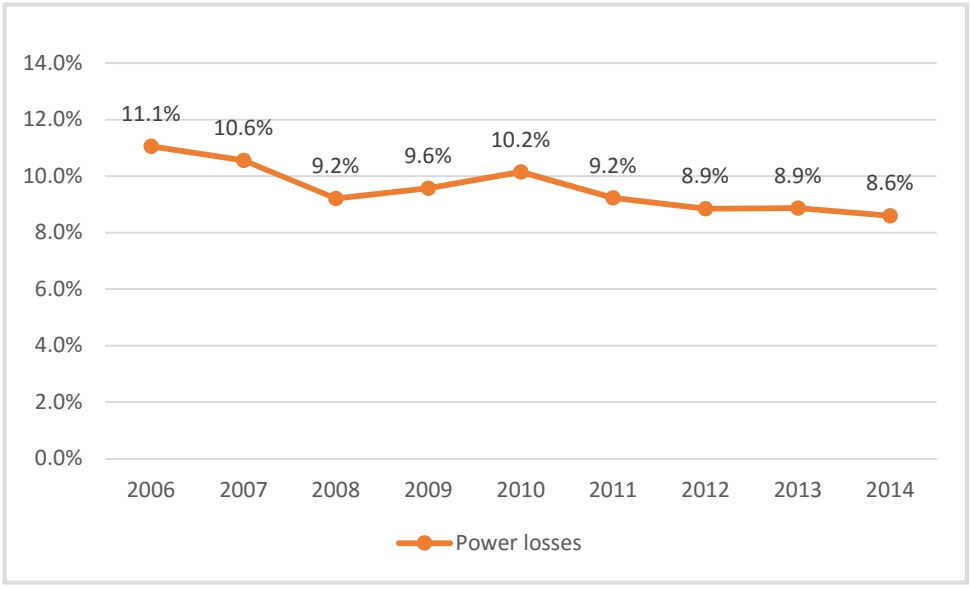
EF-Emission factor, Max-Maximum, Min- Minimum

Source: IGES, 2015

A-3.5 Indicator D III-2: Transmission losses

Transmission losses in Viet Nam have slowly decreased since 2000 but by 2014 still almost 9 % of electricity produced is lost (Figure A- 18). Losses accumulate to almost 13 TWh with an associated carbon - footprint of 8 $MtCO_2$[11]- 2.4 % in the distribution grids and 6.2 % in the transmission grids (Siemens, 2013).

Figure A- 18: Power losses (in %) between 2006 and 2014

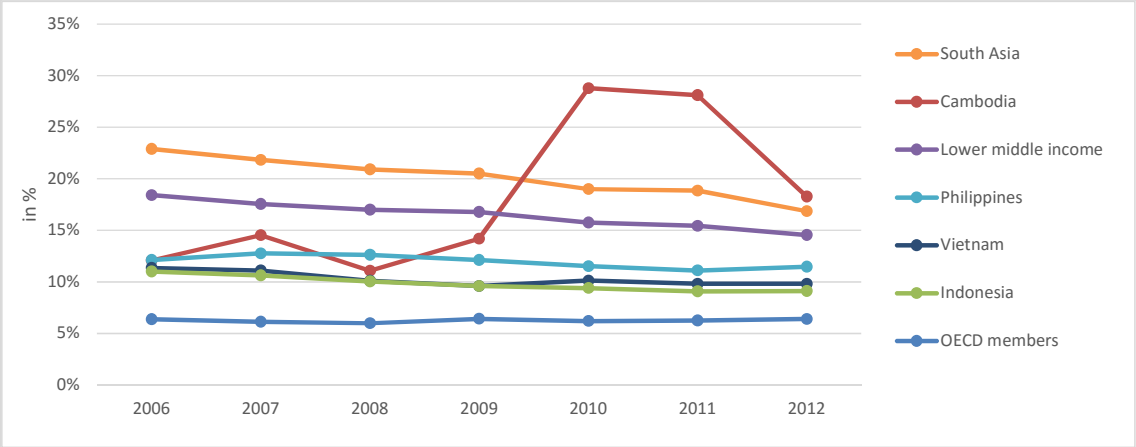


Source: own illustration based on EVN (2013b), EVN (2015b)

Transmission losses are lower than in other lower-middle income countries but significantly higher than in OECD countries (Figure A- 19).

[11] Utilizing the grid electricity emission factor of 2011/2012 of 0.636 tCO_2 /MWh (IGES, 2015).

Figure A- 19: Electric power transmission and distribution losses (in % of output) of Viet Nam and other countries

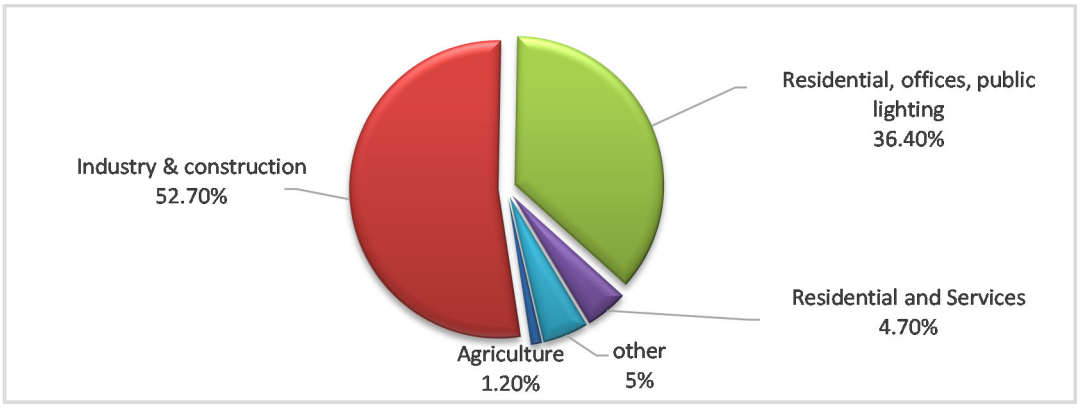


Source: World Bank (2015b)

A-3.6 Electricity demand by sector

Figure A- 20 shows the electricity consumption by sector for the year 2012. Electricity consumption is dominated by the industrial sector (53 %) followed by residential consumption (36 %). Service industry and agriculture play a minor role.

Figure A- 20: Electricity consumption in Viet Nam by sector in 2012



Source: EVN (2012)

In 2010 the largest industrial electricity consumer were the paper industry (5.4 %) followed by cement (4.6 %) and steel industry (4.2 %) (Table A- 8).

Table A- 8: Share of electricity use by industry (in % of total energy)

Electricity use	2007	2008	2009	2010
Steel	1.9	2.08	2.66	4.22
Fertilizers	0.39	0.43	0.55	0.88
Cement	2.08	2.28	2.92	4.63
Paper	2.43	2.66	3.4	5.39

Source: SE4all (2012)

A-3.7 Frequency and time of outages

The system average interruption duration index (SAIDI) of Viet Nam for 2014 was 3,134 Min (EVN 2015b), a decrease from 4,461 Min in 2014 (ENV 2013b). Large differences remain between different regions (CIF, n.d.). Momentary average interruption frequency index (MAIFI) was 2.63 per customer, decreased by 26 %.

The Bloomberg NEF Climatescope Ranking (2015) rates the power outage frequency of Viet Nam as "regular" while the power outages duration is rated as "very long".

A-3.8 Electricity retail price

Viet Nam household customers pay according to a six-level tariff schedule for rural and urban areas.[12] Low-income households receive an electricity credit of 30 kWh.[13] In 2015 average residential electricity price was set at VND 1,622/ kWh (Thanhien News 2015). Electricity prices were increased between 2014 and 2015 by 7.5 %.

According to LEEN GmbH (2015) the electricity prices for the industry and the commercial sector are not subsidised on a relevant scale. On medium voltage level the electricity prices for non-residential consumers ranges between 6 and 11 Euro ct per kWh (off peak and peak). On high voltage level the range is between 3 and 6 Euro ct (LEEN GmbH, 2015). This would correspond with the ADB (2015) claims that electricity tariffs range between USD 0.03/kWh to USD 0.16/kWh.

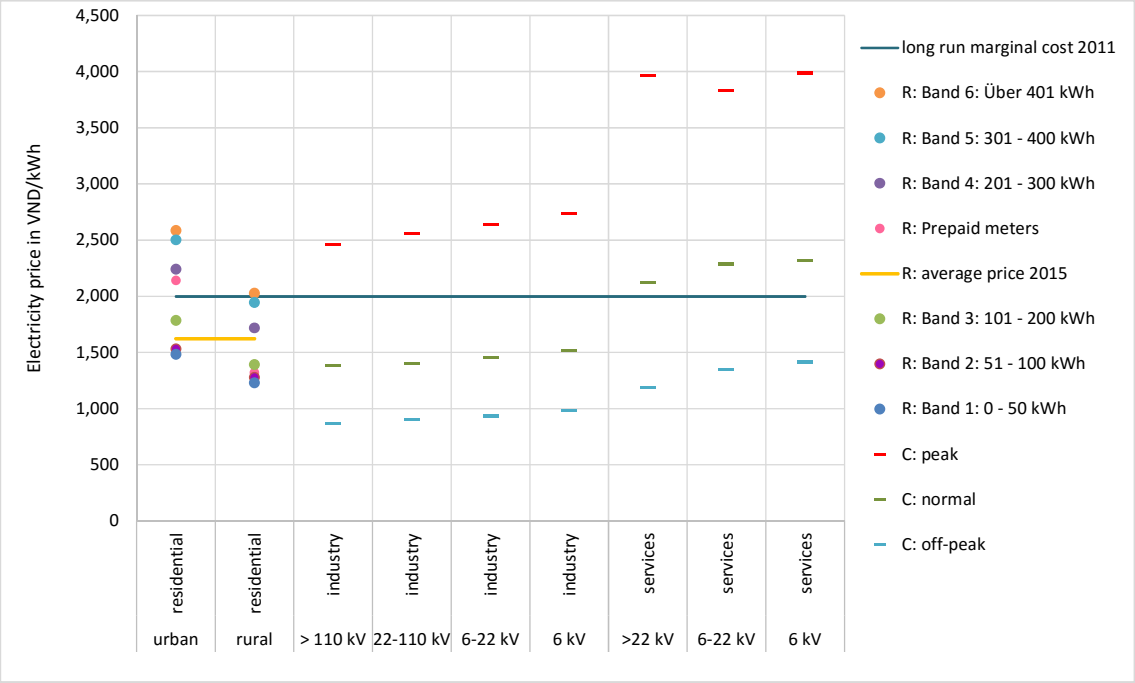
Figure A- 21 shows the tariff structure for residential, industrial and service industry customers in relation to the long run marginal costs according to Khanh (2012)[14] and the average residential price according to EVN reports (Tuoitrenews 2015a).

[12] The price is calculated as followed, e.g. for a 240 kWh urban consumer: Base tariff = (50 kWh*1.484 VND) + (50 kWh *1.533 VND) + (40 kWh *1.786 VND) = 244,519 + 10 % VAT = 268.97 VND

[13]Viet Nam introduced the lifeline tariff, and households officially classified as poor receive a cash transfer of 30 kWh consumption per month at the price of the first block. (MECON Project, n.d.)

[14] Khanh states long run marginal costs of 9.5 USD ct/kWh for 2011, these were converted into VND using a 2011 currency conversion rate of 21,033.

Figure A- 21: Electricity price tariffs of different customers in 2015



R: Residential, C: Commercial

Normal: Mo-Sat 4:00-9:30, 11:30-17:00, 20:00-22:00, Sun: 4-22:00; off-peak: Mon-Son: 22:00-4:00, Peak: Mo-Sat: 9:30-11:30, 17:00-20:00

Source: Electricity Pricing in the Residential Sector: Mecon Project (n.d.), marginal price: Khanh (2012), average residential price: Tuoitrenews (2015a).

A-3.9 Indicator D III-3: Service and quality of electricity provider

The "getting electricity" category of the Wold Bank Doing Business Index can be used as a proxy to assess EVNs service provided to its customers. In the category "getting electricity" Viet Nam ranks in the lower half at 108 of 189 countries.

Table A- 9: List of indicators comprising "getting electricity" of the World Bank Doing Business Index.

Indicator	Viet Nam	East Asia & Pacific	OECD high income	Explanatory notes
Procedures (number)	6	4.7	4.8	The number of procedures to obtain a permanent electricity connection. A procedure is defined as any interaction of the company employees or the company's main electrician with external parties
Time (days)	59.0	74.1	77.7	The number of days to obtain a permanent electricity connection. The measure captures the median duration that the electricity utility and experts indicate is necessary in practice, rather than required by law, to complete a procedure.
Cost (% of income per capita)	1,322.6	818.8	65.1	The cost is recorded as a percentage of the economy's income per capita. Costs are recorded exclusive of value added tax.

Indicator	Viet Nam	East Asia & Pacific	OECD high income	Explanatory notes
Reliability of supply and transparency of tariff index (0-8)	3.0	3.6	7.2	The reliability of supply and transparency of tariffs index is calculated on the basis of the following six components: duration and frequency of power outages, tools to monitor power outages, tools to restore power supply, regulatory monitoring of utilities' performance, financial deterrents aimed at limiting outages, and transparency and accessibility of tariffs.

Source: World Bank (n.d.-a)

The procedure is that is necessary to get electricity is outlined in Table A- 10.

Table A- 10: Procedure to get access to electricity in Viet Nam

	No.	Procedure	Time to Complete
	1	Submit application to EVN HCMC and await clearance	7 calendar days
*	2	Obtain external inspection by EVN HCMC	1 calendar day
	3	Obtain design approval and excavation permit from Traffic and Transport Department	15 calendar days
	4	Hire private firm to design and carry out external works	20 calendar days
*	5	Get design of substation certified by Fire Fighters Prevention Department	30 calendar days
	6	Obtain meter installation and final connection from EVN HCMC	7 calendar days

** Takes place simultaneously with another procedure.*

Source: World Bank (n.d.-a)

A-3.10 Indicator D III-4: Electricity Market

Viet Nam's energy sector is in transition from a single-buyer market model to a competitive retail market system.

The government began the partial restructuring of EVN in 2003, identifying several generation and distribution assets for partial privatization in a process that it referred to as equitization.

The first step in this process is the introduction of a *competitive generation power market* from 2009 onwards *followed by a competitive wholesale power market from 2017 onwards and finalized by competitive retail power market* from 2024 (Vietnam Energy, 2014). The Viet Nam competitive wholesale market (the second phase of the power market) will be introduced as a pilot in the period 2015 – 2017 (EVN 2015b).

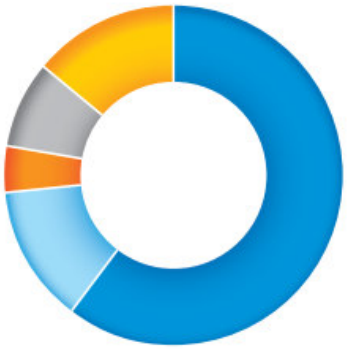
The generation segment has been opened up to build–operate–transfer (BOT) and independent power producer (IPPs) projects. The distribution sector has also been opened up to private distributors, particularly those in rural areas not covered by EVN's distribution network (ADB, 2015).

In 2014 60 % of power generation was owned by EVN, 13 % by PVN and 4 % by Vinacomin (Figure A-22). The remaining capacity was owned by local and foreign investors. The market dominance of EVN is slightly lower in terms of production numbers: EVN produced 43 % of the electricity and purchased 57 % (EVN, 2015b).

Plans exist to restructure key energy corporations such as EVN (Decision 782/QĐ-TTg of 23/11/2012), PVN (Decision 46/QĐ-TTg of 5/1/2013), and VINACOMIN (Decision 314/QĐ-

TTg of 7/3/2013) (UNDP, 2014). The generation side of EVN was reorganized into three power generation companies in 2012 based on the reorganization of EVN's existing plants. They are to be fully separated from EVN when the competitive wholesale market commences (ADB, 2015).

Figure A- 22: Power generation capacity by ownership



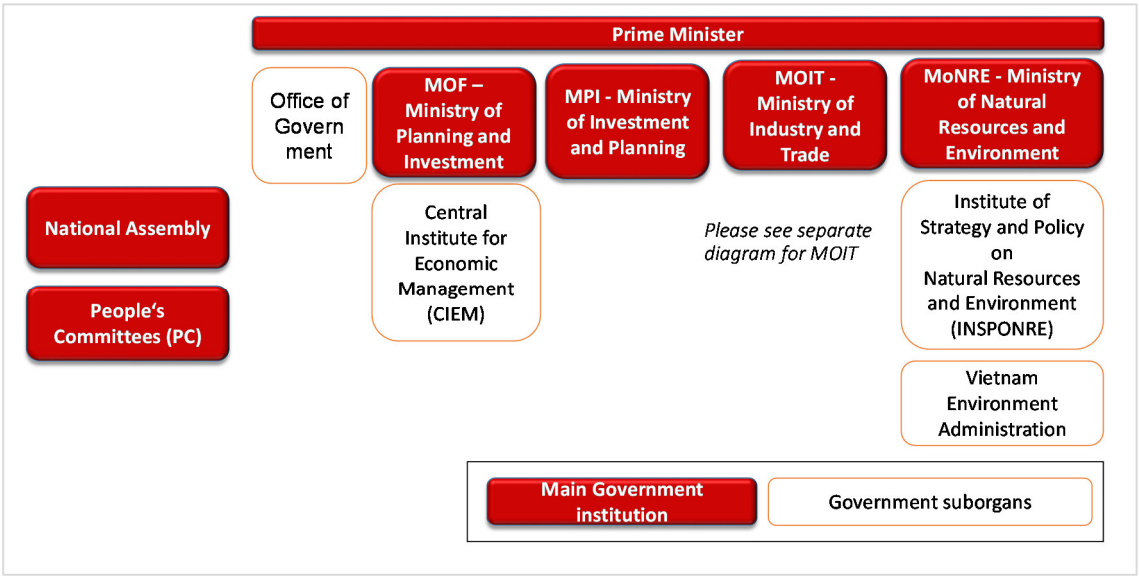
Owner	Capacity (MW)	Rate (%)
EVN	20,539.65	60.27
PVN	4,429	12.99
Vinacomin	1,485	4.37
Local investors	4,765.6	13.98
Foreign investors	2,859.5	8.39
Total	***34,080***	***100***

Source: EVN (2015b)

A-3.10.1 Institutional and market actors in the electricity sector

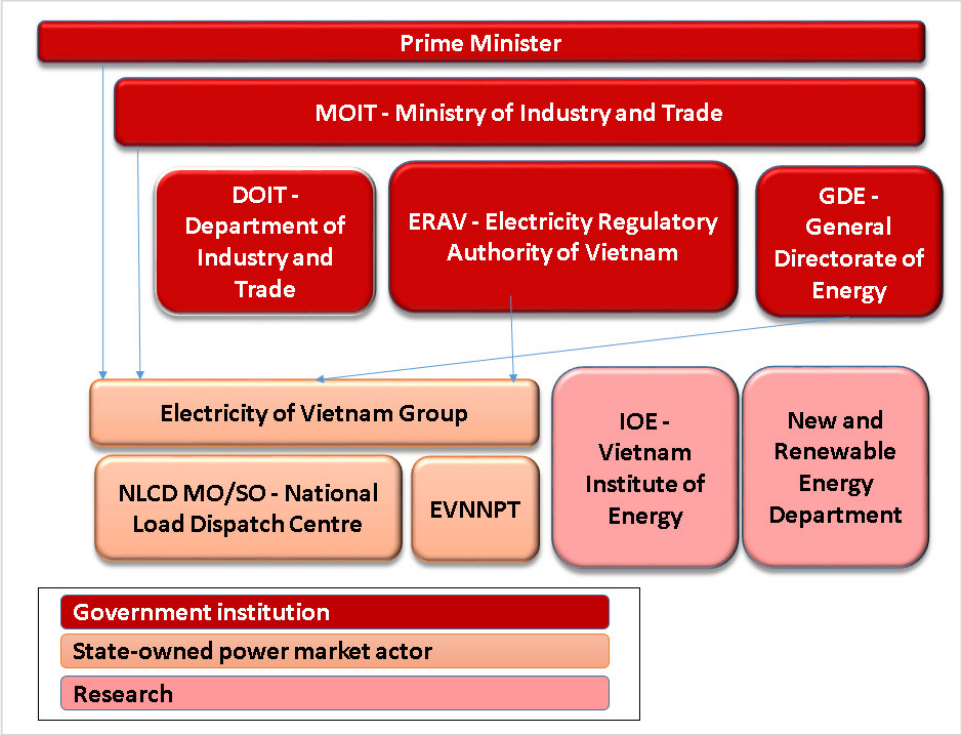
The following figures present the institutional and market set-up of Vietnam in the field of energy and climate change. Table A- 11 describes the roles and responsibilities of these actors.

Figure A- 23: Institutional framework of the energy sector in Viet Nam



Source: GIC/AHK (2015) based on EVN 2015a

Figure A- 24: Institutional framework of the energy market in Viet Nam



Source: GIC/AHK (2015) based on EVN 2015a

Table A- 11: Institutional actors around the energy market

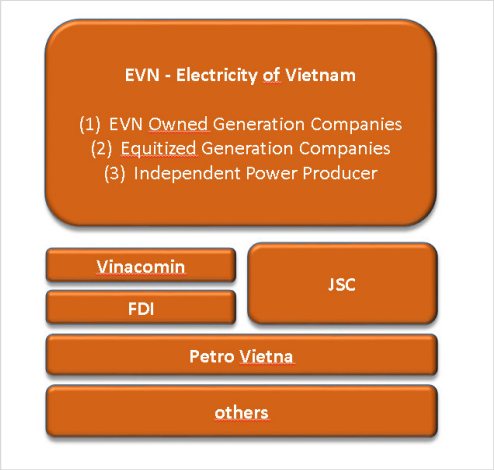
Short	Name	Description of function
DOIT	Department of Industry and Trade	On local level DOIT supports the People's Committees with the administration of the energy sector. DOIT is supervised by MOIT and receives instructions from there. DOIT is responsible for carrying out the power master plans and the use of renewables (GIC/AHK, 2015). At the provincial level, the provincial DOITs are responsible for implementing state management directives for the energy sector, including renewable energy projects (tkn & iisd, 2012; ADB, 2015).
ERAV	Electricity Regulatory Authority of Viet Nam	ERAV is responsible for the power market establishment and supervision, power planning, tariff regulation, and licensing. (ADB,2015). ERAV a department under MOiT. This department manages and regulates electricity market-related activities (also including electricity from renewable sources (tkn & iisd, 2012).
EVN	Viet Nam Electricity Group	EVN is a state-owned enterprise, founded in 1995 responsible for developing and managing electricity production, transmission, and distribution. The EVN Group is the successor of the vertically integrated, state-owned power utility.
EVNCPC	EVN Central power Cooperation	EVNCPC is financially supported by the World Bank to install approximately 10,000 electronic meters with a total investment of approximately 100 bn Vietnamese Dong.
GDE	General Directorate of Energy	Under control of MoIT the GDE is responsible for overall energy sector policy and planning. (ADB, 2015)
IOE	Institute of Energy	State Energy research institute, originally connected to EVN, currently under the direct supervision of MOIT (GIC/AHK, 2015). IOE undertakes and prepares energy sector plans, strategies, and policies (ADB, 2015).
MOF	Ministry of Finance	MoF is responsible for taxation and energy tariff policies applied to the energy sector (tkn & iisd, 2012).
MOIT	Ministry of Industry and Trade	MoIT manages all energy sectors, such as coal, oil, gas, electricity, nuclear energy and renewable energies. The ministry is responsible for policy design and national plans subject to Prime Minister's approval. (tkn & iisd, 2012) MOIT is in charge of energy.
MoNRE	Ministry of Natural Resources and Environment	MONRE is involved in the fields of natural resources, water, minerals and issues like climate change and environmental protection (GIC/AHK, 2015).
MPI	Ministry of Investment and Planning	MPI takes the lead role in coordinating and allocating funds for energy projects submitted by line ministries and agencies, for consideration and approval by the Prime Minister (tkn & iisd, 2012). MPI is leading the Green Growth and the focal point of the Green Climate Fund.

Short	Name	Description of function
PC	People's Committee	The 58 provinces and 5 city administrations are each controlled by one PC. On provincial level, and PC is responsible for approval of provincial power planning and the approval of small-hydropower and wind energy projects (GIC/AHK, 2015).
RED	Renewable Energy Department	RED is in charge of designing plans for renewable energy development (tkn & iisd, 2012).

Source: Own illustration

Figure A- 25 shows relevant actors of energy production and supply.

Figure A- 25: Electricity sector actors



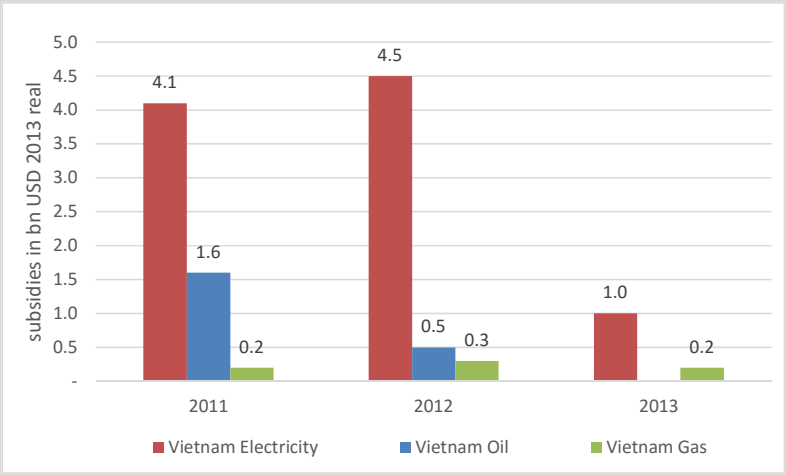
Source: own illustration

A-3.11 Indicator D III-5: Energy subsidies and fiscal impact

Viet Nam is capping electricity and fossil fuel prices differentiated for different users. The power sector losses of state owned energy companies are ultimately paid for by the central government, putting a burden on the state budget. The IEA estimates with the 'price-gap approach' that (indirect) fossil fuel consumption subsidies in Viet Nam in 2007, 2008, 2009 and 2010 were USD 2.1 bn, USD 3.56 bn, USD 1.2 bn and USD 2.93 bn respectively, and were allocated especially to electricity, i.e. fluctuating between about 1 and 4 % of GDP incurrent USD (UNDP, 2012). The subsidy amount in 2010 was estimated at 2.69 bn USD, equivalent to 2.83 % of GDP in the same year (IEA, 2011 in Khanh, 2012).

EVN is running a yearly operational deficit. In 2014, it reached USD 790 M (Vietnamnews.vn, 2015). EVN announced losses in 2014 were due to increasing coal prices and water taxes, as well as spending on the construction of power grids in rural areas.

Figure A- 26: Energy subsidies in Viet Nam



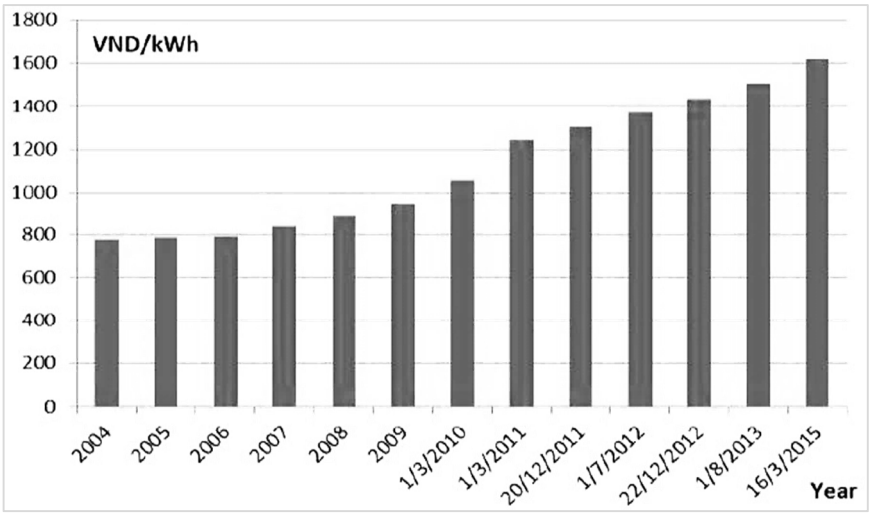
Source: IEA (n.d.-b)

UNDP (2012) states that "clearly electricity tariffs are below the long run marginal cost of supply, and EVN cannot achieve financial sustainability without increases in tariffs and reform of investment policy". The average price is estimated to need to rise to 8-9 USD ct/kWh to allow the sector to operate on a sustainable financial basis (Do, T. M., 2011), which according to UNDP (2012) would still be low by international

comparison. The weighted average retail electricity tariff in Viet Nam in 2011 was only 6.0 USD ct/kWh while the Long Run Marginal Cost (LRMC) was 9.5 USD ct/kWh.

Minimal increases of the electricity prices can be carried out by EVN autonomously, increases between 2-5 % need to be approved by MOIT. For an increase of more than 5 % MOIT needs to review the increase and it needs to be approved by the prime minster (Vietnamnews 2013 in GIC/AHK, 2015). EVN can change prices only every 6 months, which makes it leass flexible than before 2011 in terms of frequency of price increases (every 6 months instead of 3 months) (UNDP, 2014).

Figure A- 27: Development of the average electricity price between 2004 and 2015 (in VND/kWh)



Source: IOE (2015) in GIC/AHK (2015)

The government had announced in its National Climate Strategy 2011 to establish a new price system for efficient use of energy by 2015, this announcement has not been put in practice. In addition, the VGGS 2012 announced to "build a roadmap to phase out subsidies for fossil fuels" which has not been carried out until the end of 2015.

Barriers to adjustments of electricity prices to sustainable levels are social opposition by households, adjustment fears by trade-exposed industries, businesses, and high inflation rates. According to government consultants, a price increase of 10 % is expected to cause an increase in inflation of 0.5 % (GIC/AHK, 2015). UNDP (2014) has prepared a Roadmap for fuel fiscal policy reform.

The subsidies pose three major problems:

(1) Low electricity prices prevent electricity savings by customers and lead to industrial consumers loosing competition with other industrial locations whose efficiency is steadily increasing.

(2) The financial position of the national energy companies is too weak for investment in infrastructure and capacity expansion. Therefore, either investment is not carried out or expensive capital acquisition in forms of credits and loans is required. In 2011 for example, the electricity price in Thailand was 10.6 USD ct/kWh compared to 6 USD ct/kWh in Viet Nam and, therefore, not attractive for local and foreign enterprises to invest in new generating capacity in Viet Nam (ADB, 2012b in Khanh, 2012). The capital investment needed to meet power demand is expected to be USD 48.8 bn between 2010 and 202058, but EVN cannot finance this expansion from its own resources (UNDP, 2012).

(3) Energy subsidies prevent market access for renewables.

Among donor and international effort in Viet Nam energy sector has been the „Green Growth, Fossil Fuel Fiscal Policies and Greenhouse Gas Emissions in Viet Nam" program co-funded by UN, UKFCO, UNDP. The overall objective of the project was to develop a roadmap for fossil fuel fiscal policy reform in Viet Nam to gradually reduce its indirect subsidies on fossil fuel (GreenID, n.d.[15]).

[15] Excel provided by Green ID on stakeholder activities.

- Phase I (2011)- strongly influenced green growth policies in Viet Nam that include a commitment to phase out (indirect) fossil fuel subsidies)
- Phase II (2012-2013) formulated a broad roadmap for (gradual) reform to this end.
- Phase III (2014 - 2015)- to deliver suggestions for fiscal policies that will reduce long term investments in coal-fired power plants and improve efficiencies of such plants; and that will enhance investment and use of solar PV and other renewable energy over and above current plans
- Phase IV (2015 - 2016)- to focus on detailed business survey to understand better (a) energy efficiencies in energy consuming businesses and how those can improve in order to adjust to increasing energy prices; (b) potential producers, traders, and installers and service providers to solar PV.) (GreenID, n.d.).

A-4 Data presentation of dimension IV: RE-framework conditions

A-4.1 Indicator D IV-1: Hydropower potentials in Viet Nam

Regarding Viet Nam's remaining hydropower potentials ratings differ widely. While GIC/AHK (2015) states that the further expansion potential of large hydro is expected to be almost exhausted (GIC/AHK, 2015), FUAS (n.d.) states that Viet Nam's 2,400 rivers of 10 km or longer, indicating high potential for small- and large-scale hydro-electric power generation (FUAS, n.d.).

For small hydro. MOIT estimates the technical potential of small hydropower (<30MW) as larger than 4,000MW (GIZ/MoIT, n.d.).

About 120,000 small hydropower stations have been installed with a total capacity estimated at 300 MW (Nguyen Chan Giac, 2012). Small hydropower has a long tradition in Viet Nam. Meier et al. (World Bank 2015a) describe the development of SHPs as follows in the periods 1960−75 and 1981−85 extensive construction of small hydro projects was carried out in remote areas to service mini-grids. 1990−95: The use of picohydro units expanded greatly during this era—by some estimates as many as 150,000 such units, each less than 500 watts (W), had come into use. Between 1995 and 2002 SHP development slowed down further, and as the grid expanded into remote areas previously served by SHPs, these were abandoned. Some 200 stations of 5−50 kilowatt (kW) capacity stopped operation, many at multipurpose facilities (power and irrigation). Between 2002 and 2015 pico units had all but disappeared (World Bank 2015a).

A-4.2 Indicator D IV-1: Solar potentials

RE-potential assessments tend to deliver a very broad range of results due to the multitude of data inputs. Table A- 12 therefore gives an overview of data from a series of studies. The most recent assessment has been carried out by CIEMAT and was published by MOIT.

Table A- 12: Solar Potentials in Viet Nam

	CIEMAT, 2015	ADB (2015)	CIEMAT 2015	Voivontas et al., 1998	FUAS (n.d.)
Solar radition in the North	1.681 h/a		1.460-1.825 kWh/m2/year	2.4 -5.6 kWh/m2/day	2.4 - 5.6 kWh/m2/day.
Solar radition in the South	2.588 h/a		5.5 kWh/m2/day ~ 2,000 kWh/m2/year		4 - 5.9 kWh/m2/day
Direct Normal Irradiation DNI		400 - 1,500 kWh/m2/yr.	800 to 1900 kWh m-2 year		

	CIEMAT, 2015	ADB (2015)	CIEMAT 2015	Voivontas et al., 1998	FUAS (n.d.)
Average GHI	1.460-2.000 kWh/m² p.a.	1,200 - 2,000 kWh/m2	5 kWh/m2/day	4 to 5.9 kWh/m²/day	2,000-2,500 h/a

Sources: CIEMAT (2015), GIZ/MoIT(n.d.), FUAS (n.d.)

A-4.3 Indicator D IV-1: Wind potentials in Viet Nam

Viet Nam has put up a limited number of wind measurement masts, data collection is not standardized and not easily accessible (GIC/AHK, 2015). Four studies on wind potentials have been conducted (see Table A-13).

Table A- 13: Overview of studies on wind resources conducted in Viet Nam

Donors/ Funding		WB	EVN	MOIT-WB	MOIT/GIZ
	Study	Wind Resource Atlas	Wind Resource Assessment for Power Generation	Wind Resource Atlas of Viet Nam	GIZ/MoIT Wind Energy Project
	Year	2001	2007	2010	2012 On-going
	Methodology	Simulative method of atmospheric numerical model AGL, 65m	10 sites measurement for one year. At AGL 60m	Leverage the two-year measurement campaign to create a more accurate and verified wind resource map. Employ an enhanced modeling configuration, i.e., higher resolution. Compare predictions with measurements from tall towers.	Measured wind at 10 sites, 40, 60, 80m (AGL)
	Potential results	**Theoretical : 513.360 MW Fair Potential : 401.444 MW Good Potential (7-8m/s) : 102.716 MW Very good Potential(8-9 m/s) : 8748 MW Excellent (> 9m/s) : 452 MW**	**Technical Potential : 1785 MW**	**<4m/s :956.161 MW 4-5m/s : 708.678 MW 5-6m/s : 404.732 MW 6-7 m/s: 24.351 MW 7-8m/s : 2.202 MW 8-9m/s: 200 MW > 9m/s : 10 MW**	**NA yet**
	Promissing Area	the Coastal, the Central Highland and the South	The Central Coast (Quang Binh, Binh Dinh); South Central Coast (Ninh Thuan, Binh Thuan)	Central Highland, Central Coastal provinces	
	Remark	The results are probably on optimistic side. Big uncertainty would cause errors in simulative calculation	First big-scale measurement compaigne.	Measurement at 3 sites. Observed wind resource is lower than predicted	Produce wind data representative of Vietnam's areas using IEC No. 61400-12

Source: Nguyen (2012)

A-4.4 Indicator D IV-1: Biomass potentials in Viet Nam

Studied biomass resources include among others rice husk, paddy straw, bagasse (sugar cane, coffee husk, and coconut shell), and wood and plant residue.

Estimations of the potential differ between 1000-1600 MW (Voivontas et al., 1998), FUAS (n.d.)

MOIT estimates that biomass from agricultural products and residues is available at equivalent to 10 M t o_e/a. , Biogas energy potential is approximately 10 bn m^3/a, which can be collected from landfills, animal excrements and agricultural residues.(GIZ/MoIT, n.d.)

The RE-DS assumes that it is possible to extent electricity production from biomass to 85 TWh.

A-4.5 Indicator D IV-1:Geothermal potentials in Viet Nam

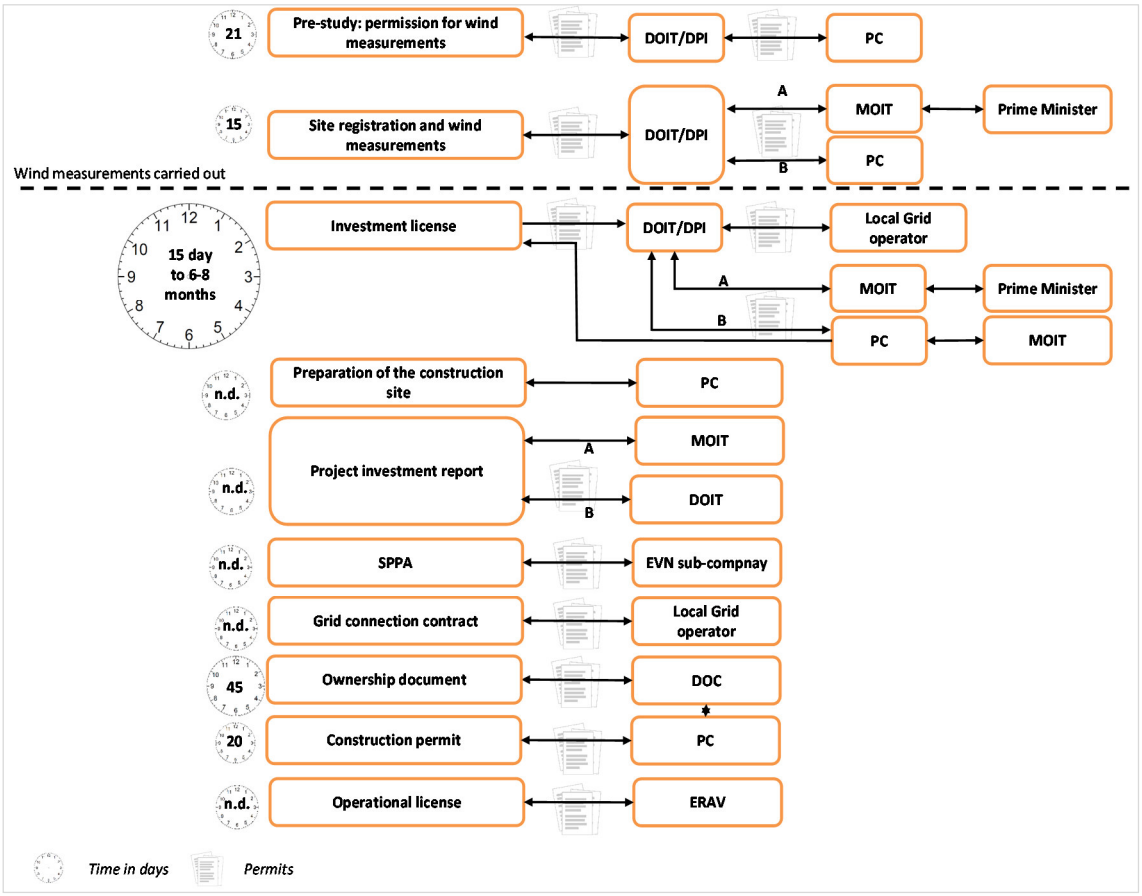
Viet Nam has 269 registered hot water springs. The geothermal potential is estimated to range between 200 - 649 MW (DLA Piper (2014 in GIC/AHK, 2015).

A-4.6 Indicator D IV-4:Grid access for wind and solar energy projects

By 2015 there was no official wind grid code for Viet Nam but it was supposed to be finalized by the end of 2015 (ICASEA, 2014) (GIC/AHK, 2015).

Since there are very few grid connected renewable energy projects (3 wind farms and less than a dozen solar projects >20 kW) there is little publicly available experience regarding procedural times from successful projects. GIC/AHK (2015) has compiled a process table summarizing the process for a wind project in Viet Nam which is presented in Figure A- 28.

Figure A- 28: Process to receive an investment, operation permit and grid access for a wind power project



DOC- Department of Construction, DPI- Department of Planning and Investment, DOIT- Department of Industry and Trade, ERAV- Electricity Regulatory Authority of Viet Nam, MOIT- Ministry of Industry and Trade PC-People's Committee,

Source: own diagram based on GIC/AHK (2015)

As shows in Figure A- 28 the process is lengthy and involves repeated contact with at least 7 institutions including the prime minister for installations of >30 MW. It is further on interesting that the process as described by the GIC/AHK (2015) does not involve an analysis of the environmental impact and no form of public participation. Both processes are of particular importants to prevent possible problems with acceptance by the local community.

A-4.7 Indicator D IV-5: RE-financial support framework

Fiscal incentives for renewable energy projects include the following:

- An incentive tax rate of 10 % for 15 years, and tax reduction of 50 % with a tax exemption of 4 years for new power projects; and tax incentives for biofuels. A preferential taxation policy offers an income tax rate of 10 % for 15 years to all renewable energy technologies, compared to the statutory rate of 25 %. Alternatively, project developers can enjoy tax exemption for the first four years and a 50 %reduction in tax payable for nine subsequent years. Depreciation on certain renewable energy assets is allowed 1.5 times faster than other property (Bloomberg NEF, 2015)
- Exemption from/rent import tax on equipment and materials (ADB, 2015, Bloomberg NEF, 2015)
- Accelerated depreciation rates (ADB, 2015, Bloomberg NEF, 2015)
- Land fee exemptions (To Manh Cuong, 2014, ADB, 2015).
- Standard-Power-Purchase-Agreements (SPPA) for renewable energy are based on a n Avoided-Cost-Tariff (ACT), which is mainly used by small hydro project.
- Additionally the following FiT exist (Bloomberg NEF, 2015):
- Since 2011, a FiT of USD 0.087/kWh for wind energy.
- Solid waste, a FiT as high as VND 2,114/kWh (USD 0.1/kWh)
- Landfill gas power projects. VND 1,532 (USD 0.07)/kWh
- Biomass-fueled combined heat and power projects, receive of FiT of VND 1,220/kWh (USD 0.07/kWh).

A-4.8 Indicator D IV-5: Small hydropower: LCOE, support mechanisms and projects

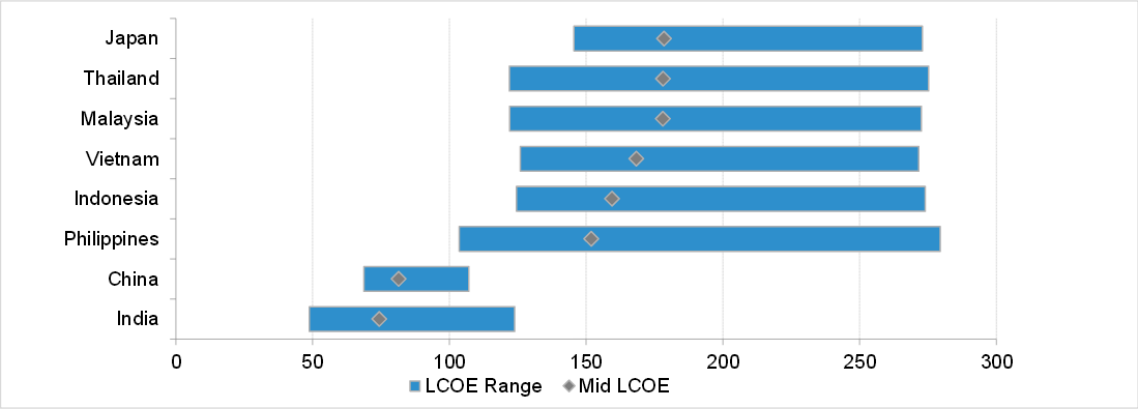
In 2009 Viet Nam introduced a Standard-Power-Purchase-Agreements (SPPA) for renewable energy based on an ACT. The avoided cost is defined as the production cost per kilowatt-hour of the most expensive power-generating unit in the national power grid, which is generally considered to be natural gas. The tariff is re-calculated on a yearly basis. In 2012, the ACT was about 4 USD ct/kWh (GIC/AHK, 2015) in 2015 it was about 5 USD ct/ kWh (ADB, 2015). Avoided cost tariff encourages daily peaking small hydro projects with a seasonally and time-of-day differentiated tariff (high remuneration for dry season peak energy) (World Bank 2015a). Therefore, the ACT has mainly benefitted small-hydro installations. Almost 2 GW of small hydro are installed by 2015 (Bloomberg NEF, 2015).

A-4.9 Indicator D IV-5: Wind power: LCOE, support mechanisms and projects

A-4.9.1 LCOE of wind power

According to Bloomberg NEF (2014) average levelized cost of electricity (LCOE)/ MWh for onshore wind in Viet Nam lay between 125 and 270 with USD/MWh an average of 168 USD/MWh (Figure A- 29). Prices are similar to those of other countries in the region like Thailand or Malaysia, but considerably higher than in more developed markets such as China or India. This price difference indicates the potentials for decreasing wind energy costs generated by market development.

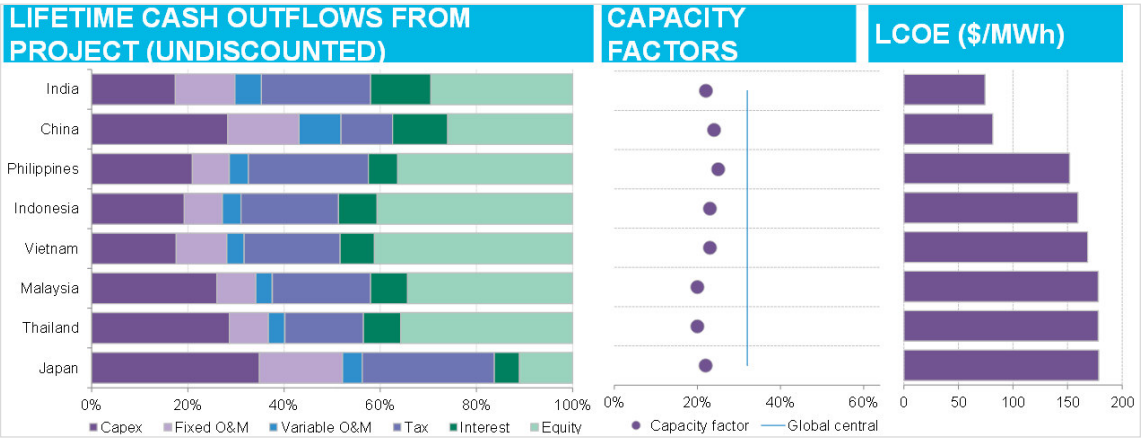
Figure A- 29: LCOE Ranges for onshore wind in Viet Nam and Asia for 2014 (in USD/MWh)



Source: Bloomberg NEF (2014)

As is shown in Figure A- 30 based on Bloomberg NEF (2014) the capital expenditure (CAPEX) for an onshore wind project such as expenditure for turbines in Viet Nam is lower than for other projects in the region and equity outflow is higher.

Figure A- 30: Cost factors and average LCOE for onshore wind in Viet Nam and Asia for 2014 (in USD/MWh)



Source: Bloomberg NEF (2014)

A-4.9.2 Support mechanisms for wind power

The wind feed-in-tariff is a combination of a fixed purchase price of USD 0.068/kWh paid by EVN and a VND 207/ USD 0.01/kWh subsidy financed from the state budget through the Environment Protection Fund. The subsidy can be adjusted by a decision of the Prime Minister (ADB, 2015). Wind power bought by EVN remains VND 388 (USD 1.5 ct) per kWh more expensive than the current market price for electricity (Thanhnien News, July 2014).

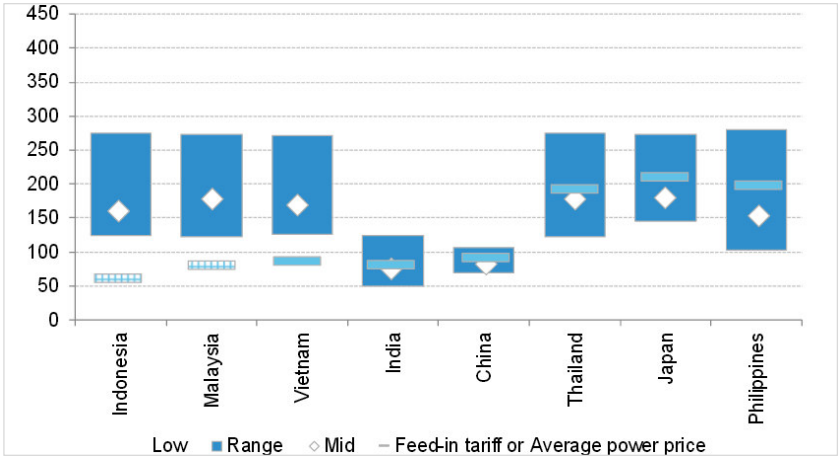
For 2015 a series of improvement of the policy framework for wind energy were planned: the wind tariff was supposed to be reviewed and increased and a monitoring system to review the tariff was supposed to be installed (GIC/AHK, 2015)

Since the range of wind power LCOE is estimated to be between 125 and 270 USD/MWh with an average of 168 USD/MWh, whilst the feed-in-tariff is only 78 USD/MWh (Figure A- 31), according to stakeholder the enumeration is far too low to make projects economically viable (Bloomberg NEF, 2014; GIC/AHK, 2015; Bloomberg NEF, 2015). Bloomberg NEF (2015) argues that among others “The government’s intended revision of the wind FiT has not taken place after several years’ consideration”.

Tran Viet Ngai, chairman of the Viet Nam Energy Association, states that „*there are many reasons for the lack of successful wind power development in Viet Nam, but the most critical is the low price of energy.*“ (Thanhnien News, July 2014)

Early wind projects in Viet Nam were probably not constructed cost effectively, since the first windfarm built with Fuhrlaender turbines, without a PPA, temporary agreement provided only 4 USD ct/kWh (Meier, P., 2012).

Figure A- 31: Wind LCOE versus tariffs in Viet Nam and Asia for 2014 (in USD/MWh)



Source: Bloomberg NEF (2014)

ADB (2015) estimates the LCOE from wind power ranging from USD 0.093/kWh to USD 0.114/kWh. In contrast to Bloomberg though ADB (2015) described the feed-in-tariff of 7.8 USD ct/kWh as „highly favorable“. And describes the conditions as „proving effective“ with installed wind capacity having increased „rapidly“, from only 8 MW in 2008 to almost 50 MW in 2015.

In contrast the World Bank Report by Meier et al. (World Bank 2015a) questions the introduction of a feed-in tariff as irrational:

„*Given that wind is very high up on the RE supply curve, and that Viet Nam has significant small hydro and biomass resources that can be exploited at a much lower cost, there is no economically rational reason for Viet Nam to pursue wind power. Only years of relentless donor advocacy have persuaded the government to introduce a wind FIT—but one set at such a low level (7.8 ct/kWh) as to have no realistic chance of enabling any wind farms.“ (World Bank, 2015a) and further on: „Pressure from GTZ and US turbine manufacturers led to issuance of a feed-in tariff for wind in June 2011 – but set at a low rate of 7.8 USD ct/kWh (only the big Chinese developers say this is reasonable!).“* (Meier, P., 2012)

A-4.9.3 Wind power projects

One of the earliest larger wind project has been the 800 KW turbine installed in Bach Long Vy Island which is in operation since 2004. The three wind farms with 20, 10 and 3 turbines each are Tuy Phong, Bac Lieu (to be expanded) and Phu Qui. KFW (2015) states that only one wind farm was connected to the grid. Asia’s first offshore wind farm went on grid in Bac Lieu in the in shallow waters of the Mekong Delta in 2013. EVN (2015b) lists for 2014 an installed wind capacity of 52 GW at three sites, this is in accordance with other sources that report an installed capacity between 52-54 MW (Bloomberg NEF, 2015, GIC/AHK, 2015; (Thanhnien News, July 2014). A capacity of 5 GW is estimated to be in the planning process (Bloomberg NEF, 2015). Even though many wind energy projects are said to be planned, this information has in the past proven to be hardly reliable and many projects have been stuck in the planning pipeline for years.

Table A- 14: Examples of installed wind power projects

Province	Location	1. pro-duction year	Installed capacity	Electricity production	No of turbines	Investment volume	Investor	Companies involved	Turbine manufacturer	sources
	Bach Long Vy Island	2004	0,8 MW							(3)
	Household wind turbines		100-200 W		~1000					(3)
Binh Thuan	Tuy Phong	2011	30 MW	2012: 54,5 GWh 2013: 46,1 GWh	20	USD 45 m	Viet Nam REVN		Fuhrlaender Viet Nam	(1),(3), (4)
Bac Lieu	Vinh Trach Dong	2013	16 MW	2013: 15,9 GWh	10	USD 244 m	Cong Ly Construction-Trade-Tourism	Huy Hoang Transportation & Logistics Corporation (HTL), Descon	GE	(1), (2), (3), (4)
Binh Thuan	Phu Qui/Phu Quy	2013	6 MW		3		Viet Nam Power Corporation		Vestas	(1), (4)
Ba Ria-Vung Tau	Co Dao Island		2.5 MW			USD 16 m	Green Resources Technology Development Joint-Stock Company			(1), (5)

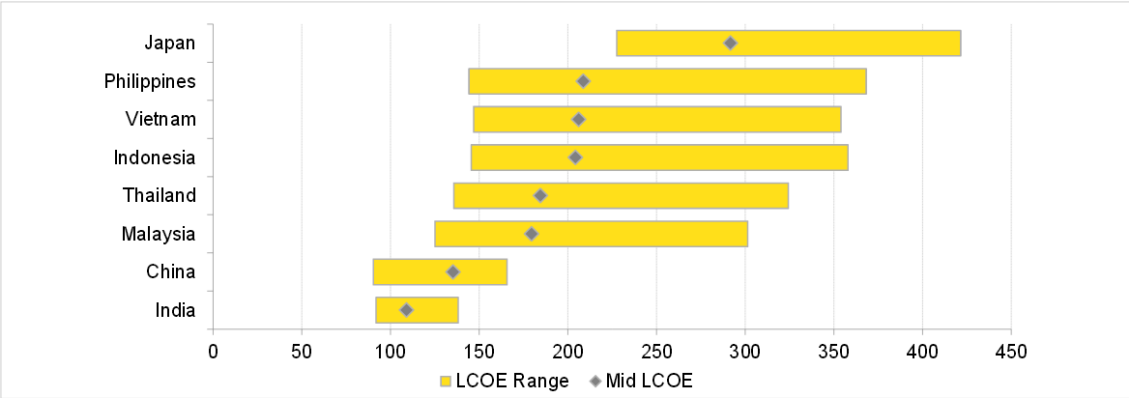
Sources: (1) EVN 2015b, , (2) Power-technology.com (n.d) (3) GIZ (2013) (4) GIC/AHK (2015)(5) Viet Nam News (2014)

A-4.10 Indicator D IV-5: Solar power: LCOE, support mechanisms and projects

A-4.10.1 LCOE of solar energy

Average LCOE/ MWh for solar energy is 210 USD/MWh with a range from 148-360 USD/MWh l (see Figure A- 32) (Bloomberg NEF, 2014). The situation is similar to wind in the sense that price ranges are similar to Thailand or Indonesia but are higher than in the more developed markets like China and India. These markets can function as an indicator that those lower prices will also apply to Viet Nam once a functional market has developed.

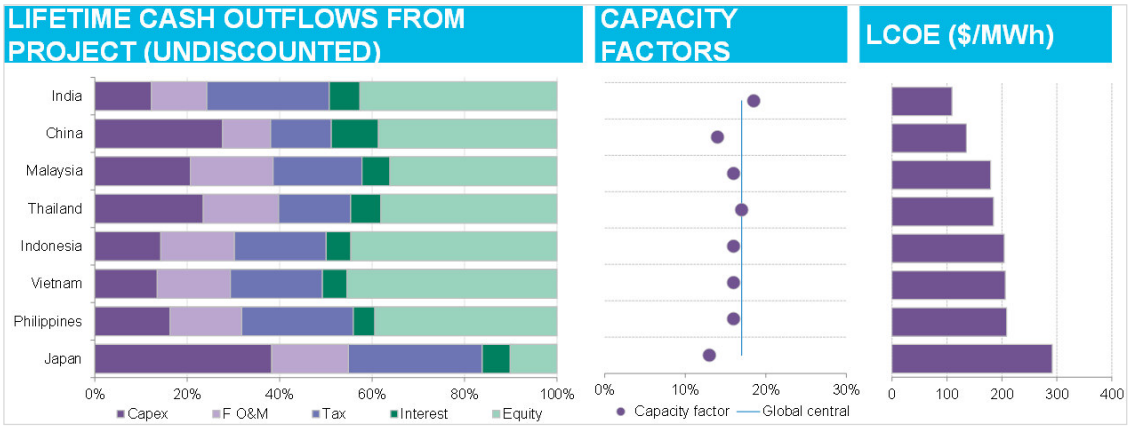
Figure A- 32: LCOE Ranges for solar in Viet Nam and Asia for 2014 (in USD/MWh)



Source: Bloomberg NEF (2014)

In respect to the cost factors as in the case of wind power the same applies to solar: as is shown in Figure A-33 based on Bloomberg NEF (2014) the CAPEX for solar projects such as expenditure for panels in Viet Nam is lower than for other solar projects in the region and equity outflow is higher.

Figure A- 33: Cost factors and average LCOE for solar in Viet Nam and Asia for 2014 (in USD/MWh)



Source: Bloomberg NEF (2014)

ADB (2015) reports a narrower price range than Bloomberg for solar ranging between USD 0.17/kWh and USD 0.22/kWh LCOE. Table A- 15 shows the distribution of LCOEs and the available areas in Viet Nam according to Lahmeyer International GmbH, contracted by the ADB to assess the low-carbon renewable and energy efficiency potential.

Table A- 15: Technical solar energy potentials and related LCOEs

Area (km²)	Potential Suitable Area ('000 km²)	% of Total Area	Technical Potential MWp	Technical Potential MWh/yr	LCOE ($/kWh)
Unsuitable area	109.10	32.94	...	...	...
Less than 1,000	...	...	...	...	...
1,000–1,100	...	...	...	...	0.301
1,100–1,200	...	...	...	...	0.275
1,200–1,300	0.04	0.01	2.5	2,586	0.253
1,300–1,400	5.23	1.58	314.1	345,836	0.234
1,400–1,500	69.92	21.11	4,195.3	4,961,641	0.218
1,500–1,600	25.48	7.69	1,529.0	1,933,035	0.204
1,600–1,700	11.37	3.43	682.4	918,346	0.192
1,700–1,800	28.26	8.53	1,695.6	2,420,234	0.181
1,800–1,900	72.61	21.92	4,356.5	6,573,592	0.171
1,900–2,000	8.19	2.47	491.1	781,158	0.162
Over 2,000	0.99	0.30	59.6	97,259	0.158
Total			**13,326**	**18,033,687**	

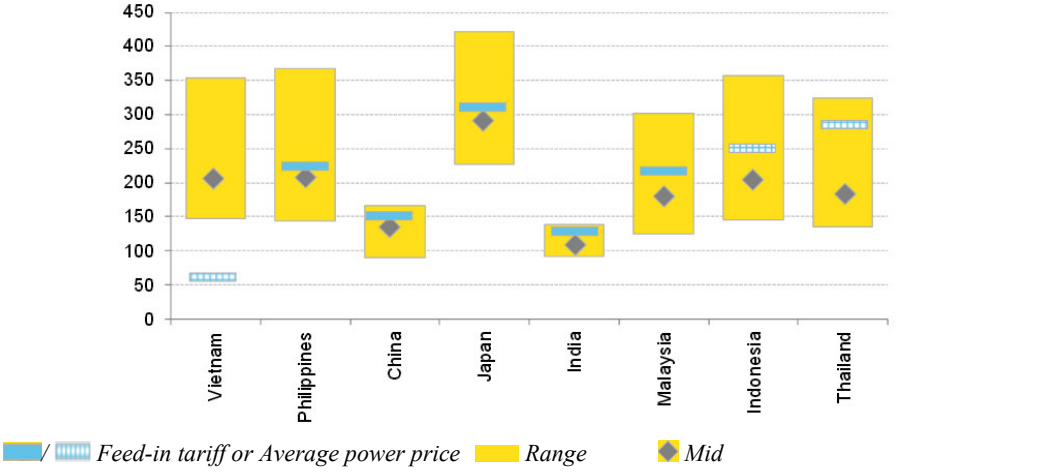
... = data not available, km2 = square kilometer, kWh = kilowatt-hour, LCOE = levelized cost of electricity, MWh = megawatt-hour, MWp = megawatt-peak, yr = year.

Source: GeoModel Solar of Lahmeyer International in ADB (2015)

A-4.10.2 Support mechanisms for solar

Viet Nam has no solar incentives and as shown in Figure A- 34 average power prices are currently too low to make solar projects viable.

Figure A- 34: Solar LCOE versus average power prices and tariffs (USD/MWh) in Viet Nam and Asia



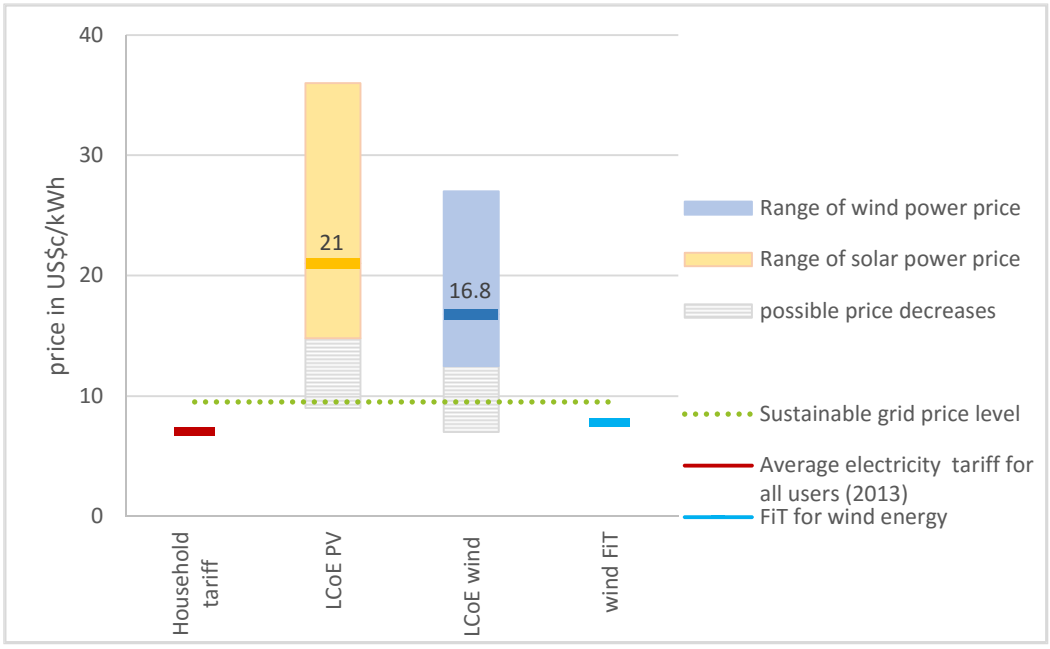
Source: Bloomberg NEF (2014)

Figure A- 35 shows the levelized cost of PV and wind in relation to the subsidized final consumer prices and a sustainable price level of 9.5 USD ct/kWh. Even though LCOEs of PV and wind are still well above 9.5 USD ct/kWh in Viet Nam, better-developed markets like India and China indicate possible price decreases once markets have developed. Once LCOEs fall below the consumer prices, business models in the field of self-consumption (without using public grid infrastructure) become viable, e.g. for the industry to use their own wind turbines and for households to install roof-top PV-systems.[16] Bloomberg NEF expect significant more cost reductions to come for PV in contrast to the other technologies, and it will be a fully

[16] Using public grid infrastructure and delivering electricity to final customers is in most countries associated with grid charges, energy charges and value added tax, in the case of self-consumption these charges frequently do not apply or they are significantly cheaper.

competitive source in only six years (2020) in much of Asia. The LCOE will be as low as USD 70-112/MWh or as high as USD 94-167/MWh depending on the solar resource (Bloomberg NEF, 2014b).

Figure A- 35: Levelized cost of PV and wind in relation to real and sustainable energy prices



Source: own diagram based on data from LCOEs and possible price decresases based on Indian and Chinese prices: Bloomberg NEF (2014), average electricity tariff for all users (2013): UNDP (2014), sustainable grid price level: UNDP (2012).

A-4.10.3 Solar project

The Vietnamese solar PV market is currently very small and mostly financed by international donors (GIC/AHK, 2015). At the end of 2014 only 4.5 MWp were installed of which 80 % were off-grid. EVN does not list any PV-installation in its annual report (GIC/AHK, 2015). The number of installations is estimated to be around 1,500 (To Manh Cuong, 2014). Among the installed capacity are a few medium-sized installations such as:

1) A MOIT-building which was equipped with a 12 kWp system in 2010 and
2) since 2014 a 36 kW project can be found in Con Dao (To Manh Cuong, 2014)
3) National Assembly in Hanoi (50 kWp) (Energypedia, n.d.)
4) the UNDP building in Hanoi (119 kWp) (Energypedia, n.d.)
5) National Conference Hall in Hanoi (154 kWp) (Energypedia, n.d.),
6) A 200 kW Intel factory in Saigon High-Tech Park,
7) 100 kW power project near Ho Chi Minh City (ADB, 2015).
8) A 212 kW parking-shade installation at the Big C Supermarket in Di An (Binh Duong province),

A-4.11 Indicator D IV-5: Biomass power: LCOE, support mechanisms and projects

In 2014 the government extended FiTs to new waste-to-energy and biomass:

- For waste-to-energy projects using solid waste, a FiT as high as VND 2,114/kWh (USD 0.1/kWh) was offered and VND 1,532 (USD 0.07)/kWh for landfill gas power projects.
- Biomass-fuelled combined heat and power projects, receive of FiT of VND 1,220/kWh (USD 0.07/kWh).
- The government is considering an additional FiT for biogas (Bloomberg NEF, 2015).

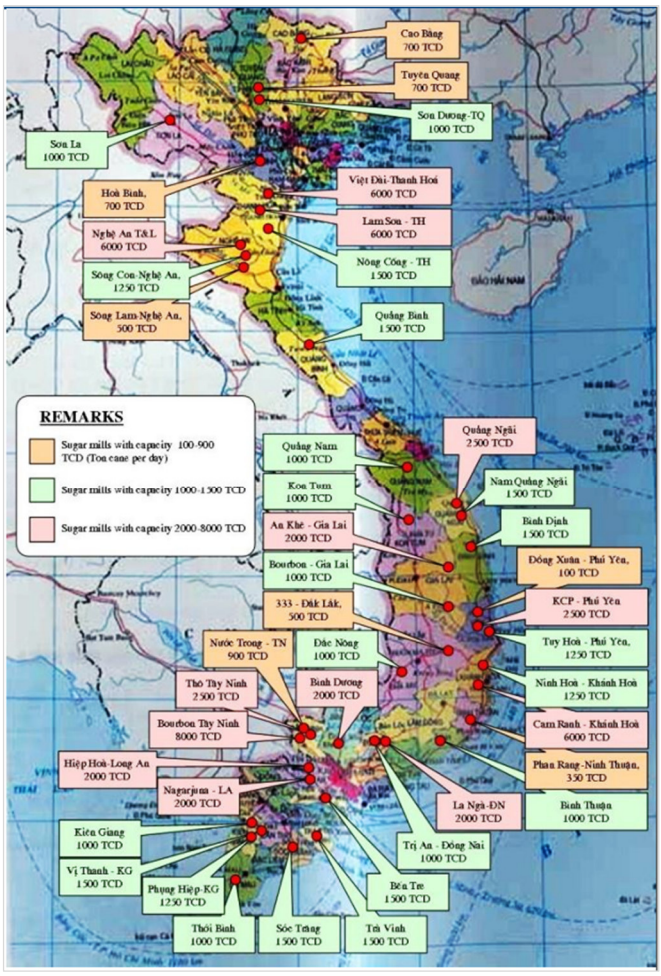
Electricity production from biomass remains low with 58 GWh produced from primary solid biofuels in 2013 (IEA, 2015). According to GIC/AHK (2015) at the end of 2015 the installed biomass and biogas capacity of Viet Nam was merely 154 MW.[17] Table A- 16 and Figure A- 36 show a list of biomass projects.

Table A- 16: Bagasse power projects in Vietnam

Name	Capacity in MW
Gia Lai Sugar	12
Soc Trang Sugar	6
Ayun Pa sugar	20
Ninh hoa Bagasses	8
Cam ranh Bagasses	11

Source: EVN (2015b)

Figure A- 36: Biomass power systems in Viet Nam



Source: GIZ (2013b)

[17] In 2015, six Bagasse-fired cogeneration projects were connected to the grid, with a total capacity of 76.5 MW. Nguyen Van Loc (2014)

A-4.12 Indicator D IV-9:RE-financing

Bloomberg NEF's Climatescope (2015) ranks 55 important developing world nations in respect to their ability and potential to attract capital for low-carbon energy sources. Viet Nam is ranked in the middle section as no.22 of 55. The enabling framework is ranked lower while the clean energy value chain is rated higher (compare Table A- 17).

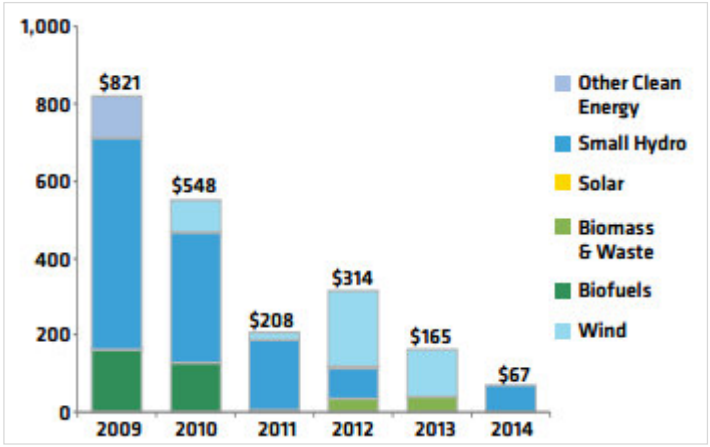
Table A- 17: Results of the Climatescope ranking for Viet Nam

Dimension	Rank	Scores
Enabling framework	35 of 55	1.05 out of 5
Clean Energy Investment & Climate Financing	**32 of 55**	**0.43 out of 5**
Low-Carbon Business And Clean Energy Value Chains	14 of 55	1.19 out of 5
Greenhouse Gas Management Activities	17 of 55	1.68 out of 5
Total	**22 of 55**	**1.28 out of 5**

Source: Bloomberg NEF, 2015

Climatescope 2015 estimates that in 2015 Viet Nam's clean energy investment dropped to USD 67 m most recently, less than half that of 2014.

Figure A- 37: Annual investment in clean energy 2009-2014 (USD m)

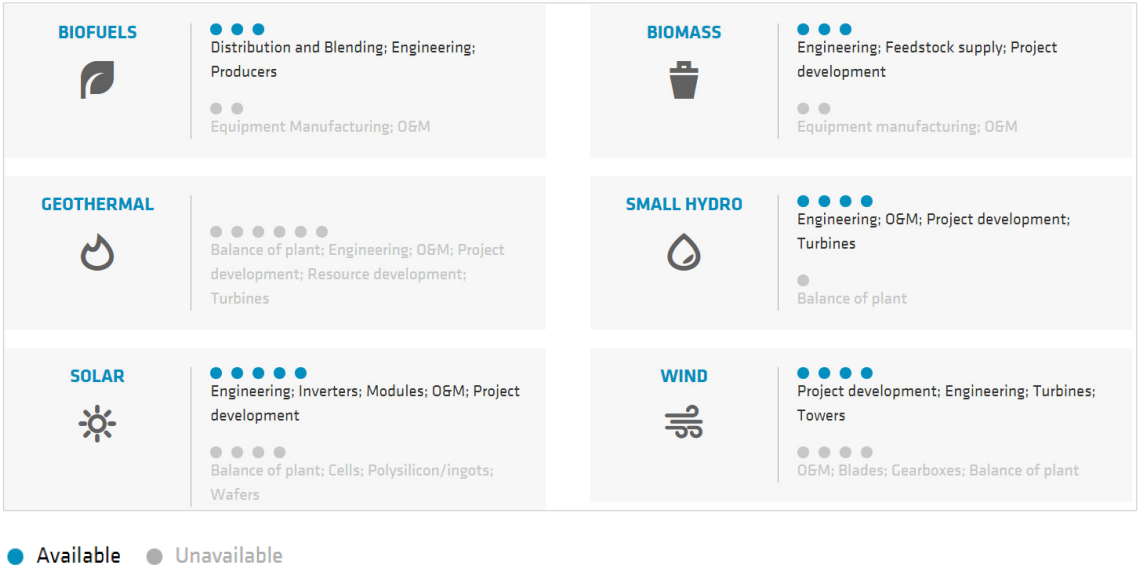


Source: Bloomberg NEF (2015)

A-4.13 Indicator D IV-10: RE-supply chain

Bloomberg NEF (2015) ranks Viet Nam in the upper third in the supply-chain dimension: rank 14 out of 55. Bloombergs rating by technology type is shown in Figure A- 38.

Figure A- 38: Bloomberg NEF assessment of Viet Nam's clean energy supply chain availability



Source: Bloomberg NEF (2015)

At the same time LEEN GmbH (2015) states that Viet Nam was importing all the technical equipment such as turbines, generators and controls to erect power plants.

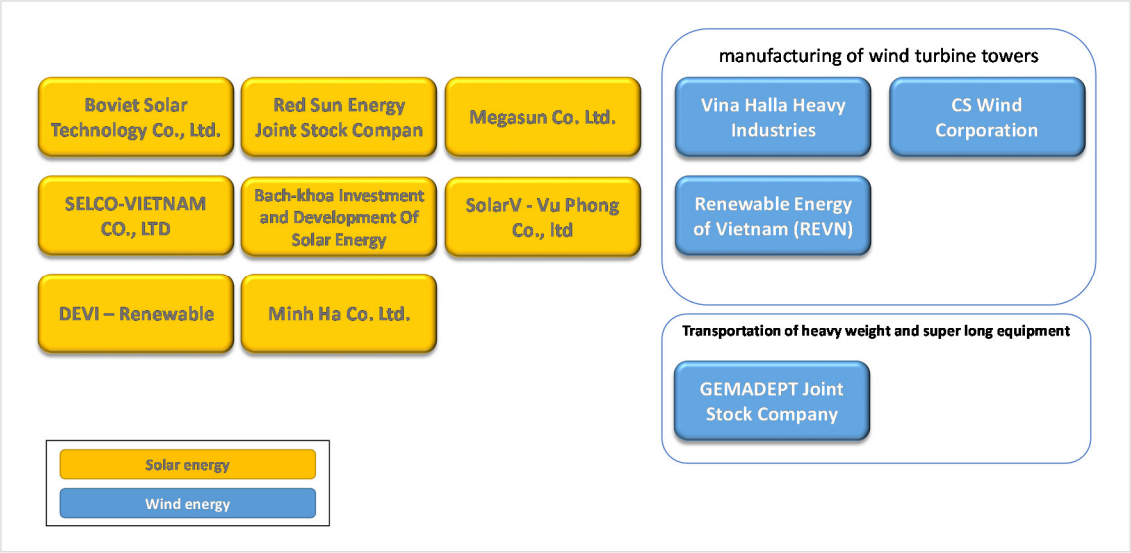
Viet Nam is considered a major global wind tower manufacturing hub (Worldwind Technology, 2014). In the field of wind turbine tower manufacturing the following companies are active in Viet Nam (non-exhaustive list): (1) South Korean owned company Vina Halla Heavy Industries, (2) South Korean owned company CS Wind Tower, (3) Renewable Energy of Viet Nam (REVN), (4) Nam Dong Duong Co., Ltd. and (5) UBI Tower Co.

Manufacturing of structural components, transportation and erection of the turbines is offered by the following companies (non-exhaustive list): (1) Lilama Erection Company 45-1, (2)Viet Nam Machinery Erection Corporation, (3)Mitsuit Thang Long Steel Construction Company (MTSC), (4)Hai Phong Equipment Manufacture & Ship Building Company (Lisemco), (5)Bach Dang Shipyard, (6)Post Construction – Investment Joint Stock Company and (8)Power construction –investment Joint Stock Company No. 5.

For the transport of heavy weight and super long equipment the following companies are available: (1) GEMADEPT Joint Stock Company, (2) Viet Nam National Shipping Lines (VINALINES), (3) Viet Nam Ocean Shipping Joint Stock Company (VOSCO) and (4) Sai Gon Shipping Joint Stock Company.

In the solar field the following companies are engaged, e.g. Boviet Solar Technology Co., Ltd., Red Sun Energy Joint Stock Company / Red Sun Energy (Long An) Co., Ltd. (Plant), SELCO-VIET NAM CO., LTD, Megasun Co. Ltd. and Bach-khoa Investment and Development of Solar Energy.

Figure A- 39: Supply chain actors of solar and wind energy



Source: own illustration

A-5 Data presentation of dimension III: Stakeholder inclusion

A-5.1 Indicator D V-1: Civil society stakeholders

Civil society involvement is important to raise awareness, generate acceptance and to access resources and funds. An active civil society will be highly beneficial to an energy transition. Among civil society activities are campaigns such as the ”no plastic”, “stop nuclear power plant”, “green drink” campaigns and youth groups protecting mangrove forests. In mid-April 2015, thousands of local residents blocked the National Highway No 1A in protest against coal dust pollution from the Vinh Tan coal power station in Bin Tuahn province. The protests of the local citizens let to the introduction of emission reductions (N.N., 2015). Important organisation in the field of energy and climate change policy are the following:

GreenID:

- Active advocate for renewable energy by developing local energy plans with communities at provincial level and replicating the model to a larger scale.

Climate change Working Group CCWG (Wells-Dank, A., 2012):

- First and most important network so far.
- Objective: reducing vulnerability of poor people to impacts of climate change through environmentally and economically sustainable and socially just responses.
- platform for NGOs to develop common advocacy agendas on climate change and build relationships with decision-makers.
- scope of work: and dialogues related to climate change, responses to participation in policy processes at both national and subnational levels.
- unifies Vietnamese NGOs and operates to build up their capacity and cooperate with the government to contribute to climate change mitigation and adaptation efforts in Viet Nam.
- places a strong emphasis on advocacy, giving feedback to the development and implementation of climate change policies through capacity building, communications and training activities at both institutional and grassroots level.
- VNGO&CC mainly influence policies via ministries

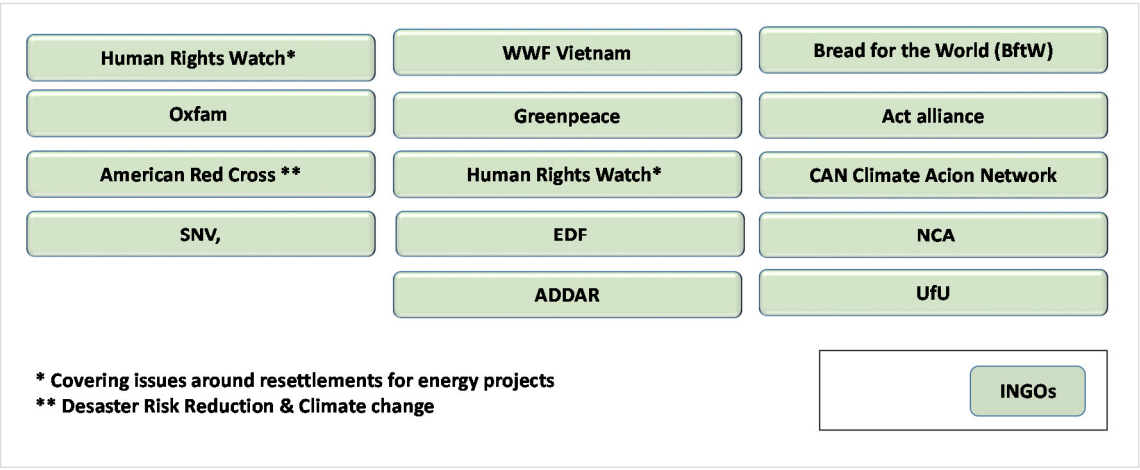
Viet Nam River Network VRN:

- VNR mainly works through the media: VRN members have appealed to remove the controversial Dong Nai 6 and Dong Nai 6A hydropower projects. To generate attention, VRN organized field trips for journalists; invited them to participate in events, conferences, and seminars; circulated research publications; started blogging and wrote articles. At some critical periods, they achieved high density media coverage reflecting the views of the scientist community
- Research on impacts of dams and flooding

Figure A- 40: Relevant civil society actors in the field of energy and climate change

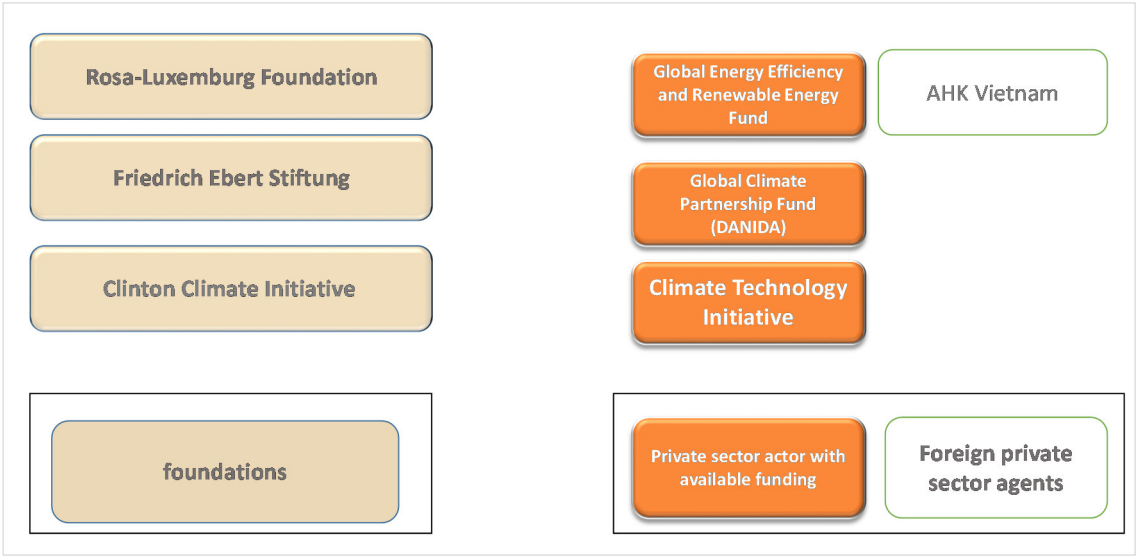
Source: own illustration based on FES (2014)

Figure A- 41: Relevant INGOs in in the field of energy and climate change



Source: own illustration

Figure A- 42: Foundations and private sector actors active in Viet Nam



Source: own illustration

A-5.2 Indicator D V-3: Viet Nam' ranking in the Environmental Democracy Index

The Environmental Democracy Index (EDI) was developed by the World Resources Institute in collaboration with partners from The Access Initiative. It ranks Viet Nam as 49 out of 70 countries. Viet Nam scores below average with a rating of 1.16 with the highest score given being 2.39 and the average being 1.42. The EDI consist of three pillars: (1) access to information, (2) public participation and (3) access to justice.[18]

Viet Nam scored well on the transparency pillar, and fair on the participation and justice pillars.

- *Transparency pillar:* EDI recognizes that there is a right to access environmental information granted to members of the public, and most relevant ministries are obligated to proactively disseminate environmental information, however, there is no requirement to release relevant and timely information during environmental emergencies.
- *Participation pillar:* According the EDI assessment the public has a right to participate in a majority of decisions that relate to the environment, but there is no requirement that participation must occur at an early *Present* of the process.
- *Justice pillar:* In the justice pillar, EDI states that there are some review procedures to ensure that aggrieved persons are afforded redress when their environmental rights are violated, but there are no assistance mechanisms in place to address gender-based barriers to access to justice.

[18] Viet Nam's EDI ranking can be found here: http://www.environmentaldemocracyindex.org/country/VNM.

A-6 Literature Annex

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