TOWARDS A SAMOA LOW CARBON DEVELOPMENT STRATEGY AND NAMA (NATIONALLY APPROPRIATE MITIGATION ACTION) IN THE ENERGY SECTOR

FINAL REPORT

of the Ecofys Fast Track Support Project for Samoa

under the Cartagena Dialogue

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EXECUTIVE SUMMARY

As a member of the Cartagena Dialogue, Samoa is among a group of progressive countries, developed and developing, that are providing leadership in the UNFCCC negotiations and encouraging mitigation actions, and support for adaptation, consistent with the objective in the Cancun Agreements to limit global warming to no more than 2^{o}C. Furthermore, as a member of the Alliance of Small Island States (AOSIS), Samoa's position is that 2^{o}C is too much warming and the goal should be 1.5^{o}C.

In developing its National Adaptation Programme of Action (NAPA), nationally appropriate mitigation actions (NAMAs) and a strategy for low carbon development, Samoa's approach is consistent with the AOSIS group's deep concerns about climate change and its international positions.

Global emissions pathways for 2^{o}C (and even more so for 1.5^{o}C) rely on large scale application of "negative emissions" technologies and systems – at gigatonne (billions of tonnes of CO_2) scale in coming decades. Negative emissions can occur when biomass is grown for use in bioenergy systems, and the CO_2 emissions that would otherwise occur are prevented from returning to the atmosphere by some form of carbon capture and storage system. The importance of negative emissions systems bears directly on key conclusions in this report, in particular the focus on biomass energy technologies that Samoa could implement, and appears to plan on doing.

Samoa is highly vulnerable to the effects of climate change. Erosion of coastlines due to wave action and the damage inflicted from strong winds during tropical cyclones have inflicted substantial economic losses in the past; in some instances the costs of cyclones has reached up to 45.6% of GDP. Environmental planning in Samoa, as in other Pacific Island countries, has therefore had to prioritise building enhanced adaptation and disaster management response capacity.

Greenhouse gas emissions in Samoa in 2007 (per the Samoa Second National Communication) were 352 kilotonnes CO_2e, about 2 tonnes per capita. However emissions have about doubled over the decade to 2007 and look set to remain on an upward trend if left without further mitigation interventions. The main two sectors are energy (about 50%) and agriculture (about 40%). Including CO_2 removals (sequestration) by forests, Samoa could be a net sink; but this removals data is considered highly uncertain and awaits the results of a current detailed study of the forest sector. Samoa has announced an objective to be a "carbon neutral economy by 2020".

Under the Cancun Agreements (the outcome of UNFCCC COP16 in 2010) developing countries are encouraged to develop low carbon development strategies or plans and also agreed to develop nationally appropriate mitigation actions, in the context of sustainable development, supported and enabled by technology, financing and capacity building, aimed at achieving a deviation in emissions relative to 'business as usual' emissions in 2020.

Samoa already has a number of strategies, plans and policies that contain elements that can link to low carbon development and which are regularly updated – in particular the Samoa Development Strategy (SDS); the Samoa National Energy Policy (SNEP); the Agriculture, Fisheries and Forestry Sector Plan; the National Policy of Combating Climate Change; and the National Greenhouse Gas Abatement Strategy. Rather than developing another "low carbon development strategy", the approach to a low carbon future can be through recognising the strengths that already lie in the existing strategies, plans and policies, and as well noting, and addressing, the weaknesses and

gaps. In short, a mainstreaming approach can be taken for low carbon development. This can begin with the next updates of the SDS and SNEP due in early-mid 2012.

With respect to the objective of "a carbon neutral economy" by 2020, a number of definitional issues and constraints have been identified that lead to a conclusion that a more viable approach – and one that will have equal international reputational merit – is to focus the carbon neutral goal on the energy sector. Delivering on this goal could be the purpose of a "NAMA Programme". A key point of such a programme is that, in addition to its focus on the energy sector, it can also draw in the forestry, agriculture and waste sectors. These can, for example, provide a source of biomass and waste resources for bioenergy and, as well, provide offset credits for additional carbon sequestration in forests and soils. (This also leaves open the potential to provide surplus offsets to international carbon market buyers.)

Low carbon makes good economic sense in the energy sector, and this is already being recognised. Samoa has a high cost diesel dominated energy system (electricity and transport fuels). Renewable electricity in Samoa therefore could eventually result in lower generation costs and retail electricity prices. Renewable opportunities utilizing domestic resources are being researched, tested and readied for investment. Recent reforms in the electricity act open the door to private sector investment in renewable power generation. Importantly, a low carbon approach to energy provides new opportunities to improve livelihoods, especially of rural communities. And using waste for energy contributes to the carbon neutral goal while addressing other environmental and health issues.

Developing such a NAMA Programme will require careful and detailed analysis. A NAMA Registry is being prepared by the UNFCCC. Details to be included are the estimated costs and emissions reductions of actions, and what finance, technology and capacity-building support is required for these actions. (A framework for the development of a detailed NAMA Programme in the energy sector in Samoa is provided.)

An initial assessment of how challenging it will be for Samoa to have a carbon neutral energy sector (also given the contributions to this goal from the agriculture, forest and waste sector) point to the importance of using bioenergy resources to "Get Off Diesel". In particular, the potential of local grown biomass-based power generation including systems to capture and store the carbon (so result in "negative emissions") can provide a crucial contribution to the carbon neutral goal. In short, the carbon neutral goal seems very achievable, given Samoa's circumstances. And these technologies and systems that Samoa can showcase will be of interest to many other developing countries throughout the Asia Pacific region and in Latin America.

To kick start the process of developing this NAMA Programme and mainstreaming "low carbon" in Samoa's strategies, plans and policies, we recommend a comprehensive and well facilitated workshop is held in early 2012 that engages all key government ministries, other public bodies and private sector and community non-government groups. This effort should also be integral to the SDS and SNEP update processes that are underway.

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GLOSSARY OF TERMS AND ACRONYMS

AOSIS	Alliance of Small Island States
AWGLCA	Ad-hoc Working Group on Long-term Cooperative Action
BECCS	Bioenergy with carbon capture and storage
Cancun Agreements	Main outcome of negotiations under UNFCCC at COP16 in Cancun
CDM	Clean Development Mechanism (under the Kyoto Protocol)
CO_2	Carbon dioxide
COP16 and COP17	The 16th (in Cancun) and 17th (in Durban) annual Conference of the Parties under the UNFCCC
EPC	Electric Power Corporation (of Samoa)
GEF	Global Environment Fund
GHG	Greenhouse gas
GOS	Government of Samoa
IPCC	Intergovernmental Panel on Climate Change
LCDS (and LCDP)	Low carbon development strategy (and plan)
LDC	Least developed country
LTA	Land Transport Authority
LULUCF	Land use, land-use change and forestry
MDGs	Millennium Development Goals
MNRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finance
NAMAs	Nationally appropriate mitigation actions (of developing countries)
NAPA	National Adaptation Programme of Action
NCCCT	National Climate Change Country Team
NECC	National Energy Coordinating Committee
Negative emissions	When an activity leads to net removals (sequestration) of CO_2 (or other GHGs) from the atmosphere
NGGAS	National Greenhouse Gas Abatement Strategy
NPCCC	National Policy of Combating Climate Change
RE	Renewable Energy
RED	Renewable Energy Division (of MNRE)
REDD	Reducing emissions from deforestation and forest degradation
S2NC	Samoa Second National Communication (to UNFCCC)
SAT	Samoa Tala
SDS	Samoa Development Strategy
SIDS	Small island developing states
SNEP	Samoa National Energy Policy
SOE	State owned enterprise
SROS	Scientific Research Organisation of Samoa
STEC	Samoa Trust Estate Corporation
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

The Cancun Agreements under the UNFCCC included a number of key elements in relation to mitigation action by developing countries:

- an encouragement to developing countries to develop low-carbon development strategies (LCDS) or plans (LCDP) in the context of sustainable development;
- an agreement that developing country Parties will take nationally appropriate mitigation actions (NAMAs) [1] in the context of sustainable development, supported and enabled by technology, financing and capacity building, aimed at achieving a deviation in emissions relative to 'business as usual' emissions in 2020;
- an invitation to developing countries to submit information to the secretariat on NAMAs they intend to implement and, as well, information on those actions for which they are seeking support, along with estimated costs and emissions reductions, and the anticipated time frame for implementation;
- a request to the secretariat to organize workshops to understand the diversity of mitigation actions submitted, underlying assumptions and any support needed for implementation of these actions; and
- a decision to set up a registry to record NAMAs seeking international support and to facilitate matching of finance, technology and capacity-building for these actions.

A number of countries have submitted NAMAs to the UNFCCC. To date, Samoa has not yet submitted a formal NAMA or pledge to the UNFCCC, although it has separately made a political commitment of a "carbon neutral economy by 2020". A number of countries that are part of the Cartagena Dialogue have also made presentations at mitigation workshops in sessions of the UNFCCC Ad-hoc Working Group on Long-term Cooperative Action (AWGLCA) in Bangkok (April 2011) and Bonn (June 2011).

This report is prepared under the *Ecofys Fast Track Support Project*. Under this project, made possible by funding from the Danish Government, developing countries participating in the Cartagena Dialogue that wish to make presentations on LCDPs or NAMAs at future UNFCCC mitigation workshops, or other such events, have received technical support to do so through Ecofys. This work is linked to the "low carbon countries" work stream within the Cartagena Dialogue.

GtripleC was contracted by Ecofys to undertake this work. Murray Ward and Shirley Atatagi made a country visit to Samoa in the week of 29 August -3 September 2011. This report is one of three key deliverables for the project. The other two are (1) a set of powerpoint slides of the key content of this report presented to Samoa officials on 18 November 2011 and (2) a draft set of powerpoint slides provided for review and use by Samoa officials at a side event at COP17 in Durban on 5 December 2011.

[1] The term "NAMAs", which is not generally used in official UNFCCC documents, has however become popularly used in UNFCCC discussions which, for example, have expanded the concept to "unsupported NAMAs", "supported NAMAs" and "credited NAMAs" – although no agreement has been achieved on the use or appropriateness of these concepts and terms.

Section 1. High Level Policy Context

2°C and 1.5°C as global goals for climate change mitigation

The *Copenhagen Accord*, struck in December 2009 by Heads of State of the world's major economies, states:

> "...We agree that deep cuts in global emissions are required according to science, and as documented by the IPCC Fourth Assessment Report with a view to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius, and take action to meet this objective consistent with science and on the basis of equity."

They also said:

> "...We call for an assessment of the implementation of this Accord to be completed by 2015, including in the light of the Convention's ultimate objective. This would include consideration of strengthening the long-term goal referencing various matters presented by the science, including in relation to temperature rises of 1.5 degrees Celsius."

A year later, the *Cancun Agreements* reaffirmed this and added "that Parties should take urgent action to meet this long term (2°C) goal".

Alliance of Small Island States (AOSIS) position on 2°C and 1.5°C

The position of AOSIS, which includes Samoa, is as follows (taken from the June 2011 submission by AOSIS to the UNFCCC contained in document FCCC/AWGLCA/2011/MISC.8):

> The long term global goal on emissions reductions must be sufficient to ensure the stabilization of GHG gas concentrations well below 350ppm CO_2e and temperature increases limited to below 1.5°C above the pre-industrial level, in order to limit sea level rise to levels that minimize adverse effects on small island developing states (SIDS) and least developed countries (LDC's).
>
> We note that currently 1CP 16 *(the main outcome decision of the Cancun COP16 climate change summit)* recognises a global term limitation goal, however we note that a 2ºC increase compared to pre-industrial levels **would have devastating consequences on SIDS and LDC's** *(bolding added)* due to resulting sea level rise, coral bleaching, coastal erosion, changing precipitation patterns, increased incidence and re-emergence of climate related diseases and the impacts of increasingly frequent and severe weather events.
>
> There is a small window of opportunity for preventing runaway climate change. In order to reach the preferred stabilization global CO_2 emissions must peak by 2015 and decline thereafter. Stabilization level suggested requires global CO_2 emissions to reduce by more than 85% by 2050 from 1990 levels. The cost of such action is readily manageable. Additionally, the cost of adaptation has a direct relationship to the level of mitigation actions.

UNEP Emissions Gap Report ... and negative emissions

The UNEP *Emissions Gap* report[2] released just prior to the Cancun Climate Summit showed that a gap of some 5-9 GtCO_2e in 2020 exists between the emissions mitigation action that, thus far, has

[2] "The Emissions Gap Report" published by UNEP in November 2010 is available at http://www.unep.org/publications/ebooks/emissionsgapreport/

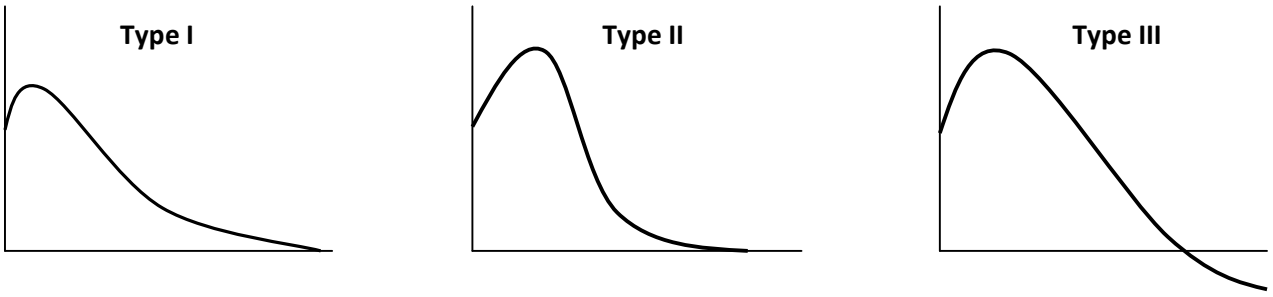
been pledged by countries (depending on the rules and interpretation of pledges) and what is needed to be on an emissions pathway that has a 'likely chance' of being consistent with 2°C.[3]

A key point about 2°C is that there are multiple theoretical pathways to get there from here – as shown in the following three simple illustrations, chosen to make some key points. They can be thought of as representing three different types of approaches to 2°C, but not all equally compatible with 2°C:

I. **peak sooner and 'lower', moderate-high emissions reduction rate thereafter to 2100** (where a likely chance to stay below 2°C is still possible)

II. **peak later and 'higher', very high emissions reduction rate thereafter to 2100** (no likely options to stay below 2°C have been modelled for such pathways)

III. **peak later and 'higher', high emissions reduction rate thereafter with substantial negative emissions prior to 2100** (a likely chance to stay below 2°C is only possible if negative emissions technology proves to be feasible)



All of these types of approaches are represented within the full range of modelled emission pathway scenarios by international science groups looking at the question of pathways to 2°C.

However in assessing the practicality of these scenarios for similar probabilities of achieving 2°C, the following key assumptions in Table 1[4] below need to be understood – and then weighed by policy makers, including being weighed with respect to the risks of not achieving 2°C and what this means about the risks of higher temperatures.

[3] The report did not calculate what (greater) level of gap existed in 2020 with respect to pathways to 1.5°C, primarily due to the lack of modelled pathways that had a likely chance of achieving 1.5°C. See the "final note" point in this section on pathways to 1.5°C.

[4] Taken from *Understanding "2°C" – And why 'slipping off 2' really matters*, Ward, M, 2011, available at www.GtripleC.co.nz

Table 1. Illustrative examples of key assumptions about different emissions pathways and their implication for 2°C

Type I	Type II	Type III	
• **Peak timing** ca. 2015 • **2020 emissions** 35 $GtCO_2e$ • **Global reductions in 2050** 40-50% cf 1990 • **Reduction rate after peak** 1% per annum • **Chance to stay below 2°C** Likely (>66%)	• **Peak timing** ca. 2020 • **2020 emissions** 44 $GtCO_2e$ • **Global reductions in 2050** 50-60% cf 1990 • **Reduction rate after peak** 2-3% per annum • **Chance to stay below 2°C** Medium (50 to 66%) There are no pathways of this kind modelled that give a "likely" chance to stay below 2°C	• **Peak timing** ca. 2020 • **2020 emissions** 44 $GtCO_2e$ • **Global reductions in 2050** 60-70% cf 1990 • **Reduction rate after peak** 3-4% per annum • **Quantity of negative emissions by sinks in 2100 (incl to offset residual emissions)** -6 $GtCO_2e$ (avg per year) • **Chance to stay below 2°C** Likely (>66%)	• **Peak timing** ca. 2020 • **2020 emissions** 48 $GtCO_2e$ • **Global reductions in 2050** 70-80% cf 1990 • **Reduction rate after peak** 3-5% per annum • **Quantity of negative emissions by sinks in 2100 (incl to offset residual emissions)** -25 $GtCO_2e$ (avg per year) • **Chance to stay below 2°C** Medium (50 to 66%)

Two issues here are worthy of some elaboration to help judge what this comparative information means in practice:

Emission reduction rates

Important factors that determine the maximum emissions reduction rate are the typical lifetimes of machinery and infrastructure. This lifespan can vary from decades or even up to centuries for building stock and urban infrastructure, around 40 years for power stations, 20 to 40 years for manufacturing equipment, up to 20 years for heating devices, and 10 to 20 years for passenger vehicles, but much longer for transport infrastructure. These lifetimes are critically important if mitigation strategies aim to avoid premature replacement of capital, which is often considered to be very expensive.

There are different views about feasible emission reduction rates. The highest average rate of emission reductions over the next four to five decades found in the integrated assessment models literature is around 3.5 per cent per year. This would imply a decarbonisation rate (of decrease in emissions per unit of GDP) of more than 6 per cent per year. Historically (1969-2009), a decarbonisation rate of about 1% has been seen globally. In Table 1, while it might seem theoretically possible to create a modelled 'likely' Type II scenario by having a very high emissions reduction rate after the peak, in fact modellers have not found this to be feasible, given these practical constraints. To have a 'likely chance' also requires significant *negative emissions*, as shown in the first example of a Type III scenario in Table 1.

Negative emissions

Global net negative emissions occur when the removal of CO_2 from the atmosphere is greater than emissions into it. To achieve negative emissions, models at present assume availability of "Bio-Energy combined with Carbon-Capture-and-Storage" (BECCS) technology. This involves using large amounts of biomass to generate energy (e.g. in place of coal) with the CO_2 emissions from that process captured and not released to the atmosphere. As biomass takes up CO_2 from the atmosphere in the course of photosynthesis, if the oxidation products (CO_2) is kept out of the atmosphere and stored, BECCS in effect removes CO_2 from the air. The feasibility of BECCS is related to factors such as future land availability and biomass productivity for biomass energy systems, as well as the future development of carbon capture and storage technology. Possible CCS technologies include:

- capturing the CO_2 and storing it in underground geologic structures;
- sequestering CO_2 using algae that can be kept in biological systems and, in turn, used to create biochar stored in soils;
- using wood in very long life applications; and
- other technologies, such as direct air capture of CO_2 that have been discussed in the literature.

A final note is that **there are no modelled emissions pathway scenarios of Types I or II that provide a 'likely chance' of meeting a 1.5°C goal.** In all cases, the 1.5°C goal requires significant negative emissions in the second half of the century which help the temperature increase to come back to 1.5°C after overshooting this level in the near future.

The importance of negative emissions technology, as set out in this high level policy framing, bears directly on key conclusions in this report, in particular the focus on biomass energy technologies that Samoa could implement, and appears to plan on doing.[5]

[5] e.g. as mentioned in the *Samoa Energy Review Report-2010*

Section 2. Samoa National Circumstance

Key points from the Samoa Second National Communication (S2NC)

Adaptation Prioritised

Climate Change is a priority issue for the Government of Samoa (GOS). The early onset of climate impacts and the fast-paced development in Samoa has compelled the development of policies and measures which seek to address the future risks and raise awareness about climate change.

The *National Policy for Combating Climate Change (NPCCC)* provides a framework for these initiatives and is designed to enhance Samoa's response to climate change while the *National Adaptation Programme of Action (NAPA)* seeks to build resilience through implementing adaptation projects in strategic areas across all sectors. The NAPA which mainstreams these actions and responses into different sectors is being implemented by cross-sector teams led by the Ministry of National Resources and Environment (MNRE) under the National Climate Change Country Team (NCCCT).

Based on the vulnerability assessments for Samoa, water, health, agriculture, fisheries and infrastructure sectors are key at-risk sectors with increased air temperatures, extreme daily rainfall and sea level rise being some of the main observed impacts. The latest climate models outlook indicated a slight decrease in frequency of tropical cyclones but increased intensity which is the key risk for Samoa. Tropical cyclones have proven to be devastating not just for the environment and the population but also for the economy[6]. Erosion of coastlines due to wave action and damage inflicted from strong winds during tropical cyclones have inflicted substantial economic losses, in some instances reaching up to 45.6% of GDP, in the past. The majority of infrastructure is located in low lying coastal areas along with a large percentage of the population. As a measure of vulnerability, Tropical Cyclone Ofa which struck in 1990 and Tropical Cyclone Val in 1991 are thought to have damaged ninety percent (90%) of infrastructure, while Tropical Cyclone Heta in 2004 is thought to have damaged twenty percent (20%) of infrastructure.

Due to its climate vulnerabilities, environmental planning in Samoa has had to prioritise building enhanced adaptation and disaster management response capacity over mitigation. However, the drivers to develop mitigation actions have increased, nurtured by all development drivers, not just economic drivers.

Rising emissions

Samoa's greenhouse gas (GHG) emissions have about doubled over the decade to 2007 and look set to remain on an upward trend if left without any intervention (see Table 2). In 2007, Samoa emitted 352.03 kilotonnes (kT) CO_2e (not including removals from the land use and forestry sector) with the energy sector accounting for half of that. In the same year the Agriculture, Forestry and Other Land use (AFOLU) sector contributed 38.4% of national emissions and registered the fastest rate of growth. The growth in the AFOLU sector is attributable to increase in

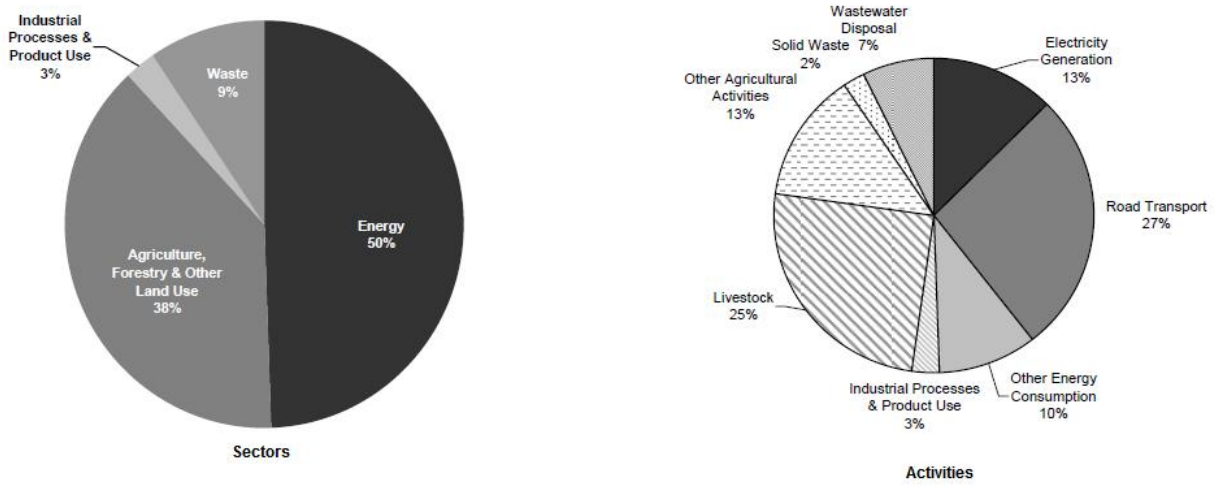
[6] Bettencourt, Sofia et al 2006. *Not if but when: Adapting to Natural Hazards in the Pacific Region. A Policy Note.* Washington, DC: World Bank (p. 2).

livestock farming which has raised methane and nitrous oxide levels in the emissions profile.[7] This makes the Energy and AFOLU sectors responsible for the bulk of Samoa's emissions (see Figure 1).

Table 2. Summary of Samoa's emissions and removals for 1994, 2000 and 2007 (kT CO_2e)

Sector	1994	2000	2007
Energy	102.83	142.74	174.35
Industrial Processes & Product Use	not available	4.59	9.51
Agriculture, Forestry & Other Land Use (excluding removals)	37.92	86.06	135.37
Waste	24.88	33.09	32.81
Total Emissions	**165.63**	**266.43**	**352.03**
Estimated CO_2 Removals			
Agriculture, Forestry & Other Land Use	-658.56	-1150.04	-785.07

Figure 1. Emissions by sectors and activities in 2007 (%) – not including removals in land use and forestry



(Source: Samoa's Second National Communication to the UNFCCC)

The change in emissions between 1994 and 2007 is attributed to increase in livestock farming, expansion of the national electricity grid, and various other activities in the energy and AFOLU sectors. In that period Samoa experienced significant economic growth, in particular including tourism which was previously not recognised as a key sector for CO_2 emissions. MNRE has also reported that an improvement to the quality of the GHG data inventory may also have had a contributing effect. A lack of comprehensive and quality data in some sectors in earlier years will have resulted in conservative estimates in Samoa's First National Communication to the UNFCCC.

Economy

Samoa is currently classified by the UN as a LDC but with a thriving economy it is scheduled to graduate from this listing soon. Samoa's GDP is approximately USD $537 million and while this may be low compared to some of its Pacific neighbours, its rate of economic growth[8] is high by

[7] Methane emissions went from 4.00 kT in 2000 to 5.59 kT in 2007; Nitrous Oxide emissions went from 0.12 kT in 2000 to 0.16kT in 2007

[8] The trend rate of growth in real GDP in the period 1994-2006 is noted as 4.2% per annum – in the SDS 2008-2012

regional standards. The country has shown steady economic progress in the last decade following a series of economic and political reforms in the 1990s[9].

Community development, improved economic and social wellbeing are key objectives that have been consistently prioritised in development plans including the current Strategy for the Development of Samoa 2008-2012 (SDS). Goals aimed at improving social wellbeing rely, among other things, on efficient and effective public infrastructure and efficient public and private sector.

The positive economic conditions which have existed in Samoa in the past decade provided an enabling environment within which some of its social and other development goals (in particular, goals set as Millennium Development Goals (MGDs)) have progressed. The establishment of the Planning and Urban Management Agency in 2004 [10] a planning tribunal to regulate land use developments and enforce conditions of development consents has introduced a more structured approach to urban and rural development projects, especially those associated with disaster risk reduction as Samoa builds its climate resilience.

But economic growth though has gone hand-in-hand with growth in GHG emissions. This situation is typical of the situation in many developing countries that have yet to decouple their economic growth from GHG emissions. The high and increasing national annual fuel bill is one of the key drivers behind some of GOS' strategies aimed at reducing fossil fuel dependency[11]**.** Successfully reducing fossil fuel imports, and thereby fossil-fuel related emissions, will not just impact the government expenditure but has the potential to decouple economic growth from GHG emissions.

Mitigation

Mitigation action is largely guided by the *Samoa National Energy Policy* (SNEP) and *National Greenhouse Gas Abatement Strategy 2008-2018* (NGGAS). The S2NC confirms that the *Government's overall objective is to change Samoa's reliance on fossil fuels to renewable energy*[12]*.*The NGGAS, which is being implemented under the responsibility of the Renewable Energy Division (RED) of the MNRE, is largely focused on improving energy efficiency and promotes but does not aggressively pursue the development of renewable energy sources. In contrast, deeper and more meaningful mitigation actions are being proposed in the SNEP, a whole of government policy developed and being driven and administered by the Ministry of Finance (MOF). The development of the SNEP led by the finance ministry suggests that the drivers of change for mitigation action may equally be economic, than just for climate policy. The success of these strategies should stabilise and, depending on the scale achieved, drastically reduce Samoa's emissions in the future.

'Carbon Neutral Economy by 2020'

Samoa is one of a few developing countries that have enthusiastically embraced the idea of carbon neutrality. Or at least, this is the message Samoa has sent to the international community with its Cabinet endorsing a roadmap of activities which it believes will help achieve a carbon neutral economy by 2020.

[9] Samoa: Consolidating Reform for Faster Economic Growth. ADB Private Sector Assessment 2008, p18
[10] Planning and Urban Management Act 2004
[11] P63 SDS
[12] S2NC pg8

The roadmap, written in the Samoan language in the Cabinet Directive F.K.(10)36 translates as follows:

(i) Proactively seek opportunities to utilise the Clean Development Mechanisms (CDM) to reduce carbon dioxide emissions;
(ii) Adopt reducing emissions from deforestation and forest degradation (REDD) and land use, land-use change and forestry (LULUCF) methodologies and incorporate these methodologies in project proposals;
(iii) Pilot the development of biomass gasification technologies that are successful at the international level and to aid this programme, recommends the planting of 1 million trees;
(iv) Strive for a carbon neutral holiday destination in the tourism sector; starting with switching all tour buses/tourist transportation to biodiesel; and
(v) Sustain internationally supported programmes such as GEF-PAS, Adaptation Fund, GEF5 SLM Project and other opportunities that are funding climate resilience, wildlife conservation and environmental management opportunities in Samoa.

The list in Cabinet Directive F.K (10)36 does not present a comprehensive roadmap of quantifiable activities nor does it attempt to define what a carbon neutral economy means. Any assumptions about the impact of the above actions on the carbon neutrality goal are not stated.

One of the key assumptions that is being implied, however, is that due to Samoa potentially being a net sink – CO_2 sequestration by forest sinks are greater than GHG emissions – this creates a better than neutral impact on global emission levels. This assumption may be flawed as it is based on limited and dated (1999) forest data. Recent GOS documentation[13] arguably contradicts the assumptions in S2NC about intact forest stocks with some plans suggesting diminishing forest stock due to forest degradation and depletion[14], threats from invasive species, diseases, and climate change[15]. There have however also been initiatives aimed at remedying some of these problems which include a ban on commercial logging in 2007, creation of national parks, reforestation and replanting programmes. While there remains no available measurements to assess the impact of these activities and actions taken to address then, a reported upcoming project by JICA may provide an opportunity for monitoring and measuring these forest resources. Also, the proposed GEF5 SLM Project will introduce the carbon calculation methodologies required in Samoa so that more accurate land use planning can take place.

The topic of carbon neutrality and the appropriateness of some of the apparent assumptions set out above are further discussed in Section 4.

Electricity Sector Reforms

The Electricity Sector has been identified as having higher mitigation and efficiency potential than the other sectors from which emissions are sourced. (Refer to Figure 1: Detailed breakdown of Samoa's total GHG emissions 2007.)

[13] SDS 2008-2012, Agriculture, Draft Fisheries and Forestry Sector Plans, KVA Consult
[14] Draft Fisheries and Forestry Sector Plans, KVA Consult p 40
[15] SDS 2008-2012 p39

Electricity generation has relied heavily on diesel generation in the past decade in which electricity demand grew at a rate of 6% per annum.[16] This growth in demand in the last decade was associated with an increase in users which came online with expansion of the national grid as well as an increase in developments in the Apia urban area. Electricity now reaches 98% of households, one of highest rates in the Pacific region.

The SNEP sets specific targets for the electricity sector. Non-fossil fuel based electricity generation is being pursued with a preference for *reliable, affordable and environmentally sound energy supply and services*[17] heralded as crucial. The S2NC identifies hydropower as having the highest mitigation potential and the most viable, though it acknowledges that the risk of increased droughts and impact of dry season on water levels are a real concern specific to this particular area.[18] The SNEP has identified energy efficiency measures as a priority first step and renewable energies, other than hydropower, as promising based on the increased research capacity in this area. In particular, having renewable energy as a key research area of the Scientific Research Organisation of Samoa (SROS) is seen as giving a boost to this area.

A recent reform of the electricity sector, as part of an overall approach to improving utility services and infrastructure, has made some key changes which will be implemented in coming years. One of the key changes is the opening up the power production market to private sector involvement. The state owned utility Electric Power Corporation (EPC) has enjoyed a monopoly in supplying electricity but the new Electricity Act 2010 has opened up the market to independent power producers (IPPs) and has established a Regulator who sets, monitors and enforces electricity tariffs and perform other functions prescribed in the legislation.

In response to these reforms, members of the private sector appear to be taking a keen interest in the IPP opportunity. Some investments are already being made in this area by companies promoting renewable energy electricity generation. A number of companies are looking to employ biofuels and bioenergy systems at significant scale. Samoa Trust Estate Corporation (STEC), a state owned enterprise, also has a strategy along these lines and sees the opportunity of being an IPP as a potential source of revenue. All of these proposals appear in line with the SNEP and the EPC goal of supplementing most of its diesel generation with renewable energy capacity. The deployment of these ideas, if done at a large scale, will not just provide competition in the market that will likely benefit consumers, but should yield positive results for Samoa's emissions profile.

Private Sector-led Economic Development

The Government appears to be giving private sector a more central role in economic development and policy formulation. Both the previous SDS and the current SDS 2008-2012 continue to prioritise macroeconomic development and seek to provide incentives to the private sector to promote economic growth and employment creation. This move recognises the contribution that the private sector makes to the economy[19] and the fact that it provides approximately two-thirds of formal employment.

[16] P10 SNEP
[17] P11 SNEP
[18] There are also unquantified concerns about methane emissions from decaying trees and other biomass in areas flooded behind dams constructed for hydropower.
[19] In 2006, the private sector was believed to have accounted for 58% of GDP ~ SDS 2008-2012

As seen already in their rapid recognition of investment opportunities in the electricity sector, private sector actors are well positioned as key players in areas where investments are sorely needed.

Private sector investments and involvement in key sectors such as tourism make the private sector an important player in any nationwide efforts to achieve carbon neutrality. The Cabinet Directive F.K.(10)36 specifically highlights the tourism sector as a sector which can reap benefits of a carbon neutral country or 'green' destination. The directive also recommends a specific action targeting transport to begin to demonstrate the carbon neutral commitment to visitors and tourists who visit Samoa.

In addition to this, upcoming changes that facilitate the economic and productive uses of customary land can enable many stakeholders to take part in the pursuit of Samoa's carbon neutral goal. Approximately 80% of land is held in customary tenure and cannot be alienated. Ongoing reforms in this area are aimed at enabling the utilisation of customary land for economic gains – something that will surely be taken advantage of by members of the community who are already actively involved in private sector development. Two potential IPPs[20] who plan to go into bioenergy are already exploring options for sourcing feed crops locally. These trends are creating the prerequisites for a more conducive business environment that maximises returns to communities if Samoa stays committed to a low carbon pathway.

[20] STEC, BioGen3 Samoa

Section 3. Samoa Low Carbon Development Strategy – Mapping the approach

> *"Samoa, finally, is committed to emitting more oxygen, absorbing more carbon dioxide, filling its carbon sinks and hopefully move towards a 'green' economy. 'Going Clean and Green' is not only good for the economic competitiveness in the long run, but a green economy can also help attract new kinds of renewable industries to Samoa and may result in further job creation and new export markets (e.g. for value adding goods; ecologically-packaged and processed organic food products; biofuels; etc"* *Hon Faumuina Tiatia Liuga, 2010*[21]

An initial evaluation of policies and strategies in this area suggests that there is a rudimentary framework of policies and measures that support a low carbon development pathway. Some of these policies have strong components which are conducive to low carbon growth that relate to the energy sector which has the highest mitigation potential. These policies have many overlaps and inter-linkages and are designed to utilise a multi-sectoral and multi-stakeholder approach, which is a positive aspect. The overlaps may also present challenges; in particular, there appears to be duplication of functions and projects in some areas and in different ministries.

Strategy for the Development of Samoa 2008-2012, SDS

The SDS is Samoa's 4-year national strategic plan which outlines key priorities of the Government and informs the national budget. Its development is a statutory requirement[22] and a key deliverable of the Minister of Finance. The strategy for the current period continues to prioritise economic and social development issues – see Figure 2.

Figure 2. Outline of National Goals and Strategies in Strategy for the Development of Samoa 2008-2012

Priority Area 1: Economic Policies

- Goal 1: Sustained Macroeconomic Stability
- Goal 2: Private Sector Led Economic Growth and Employment Creation

Priority Area 2: Social Policies

- Goal 3: Improved Education Outcomes
- Goal 4: Improved Health Outcomes
- Goal 5: Community Development: Improved Economic and Social Wellbeing and Improved Village Governance

Priority Area 3: Public Sector Management and Environmental Sustainability

- Goal 6: Improved Governance
- Goal 7: Environmental Sustainability and Disaster Risk Reduction.

Energy and transport are two of the four key service areas being targeted with specific strategies in the plans to improve economic infrastructure – work within Priority Area 1, Goal 2. This focus

[21] SOE 2006 Report Revision dated 2010, p6
[22] Public Finance Management Act 2001 (Part IV §5 and 17)

responds to growth in energy demand and the anticipation of continued growth in these sectors[23]. Almost half of the energy demand is being met by imported fossil fuels[24] which cost the GOS millions of tala every year. The increasing quantity and cost of these imports, inflated by rising global oil prices and high costs of international transport, is proving to be a key driver for renewable energy with the SDS encouraging the development of renewable energy sources.

Strategic interventions[25] which specifically target the problem of fossil fuel dependency are listed as:

(i) Promoting sustainable use of indigenous energy resources and renewable energy technologies;
(ii) Promoting partnerships with communities and all energy stakeholders, especially development partners, in the development of renewable energy programmes in Samoa;
(iii) Exploring training opportunities to build up capacity in renewable energy technologies;
(iv) Encouraging the commercial use of renewable energy research findings of SROS[26]*;* and
(v) Enhancing public knowledge and understanding of renewable energy and its costs and benefits.

The SDS aims to improve efficiency and effectiveness in the energy sector starting with the implementation of the SNEP. Recognising the extent of reliance on petroleum products it has set an indicator of *ensuring access for all to reliable, affordable and safe petroleum products*. To address economic infrastructure issues in the transport sector, the strategies include improvements in planning and regulation of land transport through the establishment of the Land Transport Authority (LTA) which is now fully operational.

The SDS highlights trends in waste management, water[27] and sanitation, the impacts of which tend to be cross cutting. These are also areas where there are major developments in international low carbon technologies some of which can address social impacts[28]. One particular low-cost technology, biodigesters producing biogas is being used by a small community in Nu'u[29]. The viability of these technologies may not have been considered at the time of the drafting of the SDS but may well feature in future SDSs.

The interconnectedness of sectors and issues in a small country is nowhere more visible than in the SDS. Many of the issues identified, even if they appear to be specific to a particular sector or ministry, are cross cutting in effect. Human and animal waste management issues for instance, are a key concern in the health sector. Efforts to increase access to customary land[30] may open up

[23] In the transport sector, Samoa's recent road-switch (from right to left side driving) means there is an influx in right-hand drive vehicles from Australia and New Zealand where many Samoans live. Due to growth in tourism and continuous development, electricity demand is expected to continue to rise.
[24] In 2000 45% of energy demand was met by petroleum products. SDS p18
[25] P41 SDS
[26] Listed in the SDS as Institute of Research and Development
[27] While there is 100% access to water supply in different forms, the actual percentage of the population with access to 'treated' safe water supply was just over 52% in 2004.
[28] e.g. biodigester technologies are designed to utilise human, livestock and biomass waste to produce biogas which can be used for cooking.
[29] The Youth With a Mission compound in Nu'u have installed a biodigester in septic tanks which collect human and animal waste; liquid overflows are used as fertilisers while the biogas which is produced from the biodigesters gets used for cooking. The compound hosts students and teachers and is almost entirely self-sufficient.
[30] P49 SDS

economic opportunities for rural and/or impoverished communities but may lead to land clearance which encourages trends in forest degradation and deforestation. Industry related pollution and use of pesticides and other agricultural chemicals are not only increasing emissions in the AFOLU sector but threaten contamination of water sources and pose health risks to people and livestock.

Samoa National Energy Policy, SNEP

The SNEP is the strategic plan for the energy sector. Developed by the Ministry of Finance in 2007, the SNEP seeks to address fragmentation in energy developments and outlines a proactive strategy aimed at reducing the economic vulnerability to the international trend in (rising) global oil prices.

The SNEP sets some modest targets:

- To increase the share of mass production from **renewable sources to 20%** by the **year 2030**;
- To increase the contribution of **Renewable Energy for energy services and supply by 20% by year 2030.**

The SNEP has identified five strategic areas in the energy sector where interventions are planned and being carried out. These are **Energy Planning and Management** and the four main energy subsectors: **Renewable Energy, Electricity, Petroleum and Transport.**

Energy Planning and Management: The ad hoc and at times donor-driven approach to renewable energy is one of the reasons the SNEP identifies improved coordination and institutional strengthening as necessary interventions. The Energy Unit within the Ministry of Finance and the National Energy Coordinating Committee (NECC) – a high level committee[31] which acts as a clearing house for all energy related activities and initiatives warranting Cabinet endorsement – are responsible for implementing the SNEP and some of the initiatives that are already being rolled out. The establishment of SROS with a dedicated Renewable Energy faculty demonstrates a commitment to research and the encouraging results[32] to date, of some of these experiments confirms the value of this investment.

Renewable Energy (RE) is the alternative to costly imported fossil fuel and one where a lot of potential is recognised which has led the SNEP to set measurable medium-long term targets/indicators for RE. Hydropower is being assumed to hold the greatest promise and thus it seems to be highly recommended. However, hydropower can face constraints in the dry season and there are also both supply and potential contamination concerns regarding hydropower's effects on drinking water. With regards to non-hydropower based sources, the SNEP makes a specific recommendation encouraging the use of findings from research that is being carried out on these. On the surface level, there does not appear to be an effective method employed to ensure research findings are successfully fed into sectors and inform decision making in those sectors as well as the NECC. This is a link that could possibly be strengthened by establishing a mechanism or formal reporting process for SROS to NECC and Cabinet.

[31] NECC is chaired by the Minister of Finance and includes the Minister of Natural Resource and Environment and the Minister of Works, Transport and Infrastructure and the Chief Executive Officers of MOF, MNRE, MWTI, AG, MWSCD, LTA, SROS, MCIL, EPC and MAF.

[32] In a meeting with SROS, it was reported that pilot biodiesel plant experimentation has proven successful and the next stage is upgrading to larger/commercial scale with potential to produce 5,000 litres per day.

Electricity: As discussed in the earlier chapter, emissions from **Electricity Generation (13%)** are already the focus of various interventions. This sector is seen to have a high mitigation potential with new hydropower capacity estimated to offer potential savings of 33 kT CO_2-e per annum. Opening up the power production market to IPPs is an opportunity that is inspiring private sector innovation with cases of active exploration into biofuels, cocodiesel, biomass gasification and other renewable energy technologies. A **solar photovoltaic** system set up on Apolima Island is raising confidence in solar technologies and prospecting for **Wind energy** is starting with data collection. Small scale pilot projects in **biomass gasification** are happening in both the public and private sectors. This keen interest, ongoing research and small successes will likely result in increased recognition of higher potential in these technologies

The clear preference for hydropower is based on assumptions about its feasibility (already accounts for a large percentage of the energy mix) and potential although it is not without limitations – access to appropriate natural water resources and funding are identified in SNEP as barriers. The S2NC identifies the water sector as facing some key risks in the next few decades so this is a possible area that warrants some assessments. Current La Nina events which are causing droughts in the region and previous and current droughts in Samoa serve to demonstrate just how vulnerable the energy and water sectors are.

Petroleum and Transport: Pursuing **energy efficiency standards** in the transport sector is being seen as an important first step, although this is arguably limited to public awareness campaigns. The newly established LTA is a key agency here. There is a slow but steady deployment of biofuel (coconut oil) and biodiesel use in vehicles and potential for deployment at scale holds promise with positive developments in developing these fuels at SROS.

Agriculture, Fisheries and Forestry Sector Plan

The Agriculture, Fisheries and Forestry sectors play a key role in social and economic development. The contributions of these sectors to the economy are significant in the areas of economic growth (Agriculture and Fisheries provide the bulk of exports), poverty alleviation, food and nutrition security, trade and employment. The agricultural sector appears focused on revitalizing its economic potential which has been set back by natural disasters, pests and diseases. Recognizing that some of these threats will increase with climate change, adaptation (to climate change) activities appear to have been successfully mainstreamed into sectoral plans.

Addressing emissions from Livestock (25%) and Agricultural Activities (13%) is a task that does not appear to be high on the agenda though and without attempting mitigation, wherever possible, the rapidly rising emissions from the AFOLU sector look set to continue.[33] While the mitigation potential may be low, there is active research in this area at the international level that is likely to yield some approaches in the next decade. In the meantime, there are low-carbon technologies, including indigenous practices that could be explored. Proactively looking for opportunities in this sector is consistent with SNEP recommendations. There are no agriculture-specific strategies in the NGGAS.

[33] This also given expectations of significantly increased livestock numbers.

The Forestry Sector is key to Samoa's assumptions about carbon neutrality. More than half of Samoa's total land[34] area is categorized as forest land, though there are different types of forest land (closed, open, secondary etc).

The current reforms aimed at maximising the economic use of customary land will open up more land to development opportunities and this may not necessarily have a positive impact on emissions. At the same time, commercial interest in biomass gasification, which will likely increase demand for local biomass feedstocks, offers opportunities for the utilisation of customary land for plantations. This will likely deliver economic benefits to communities and landowners. Cabinet Directive F.K.(10)36 prescribed a specific activity in this sector – planting of 1 million trees which is assumed to contribute to reforestation efforts and prepare for the at-scale biomass energy production. This project is reported as being on track. There is also a growing interest in agro-forestry.

National Policy of Combating Climate Change and **National Greenhouse Gas Abatement Strategy**

The **National Policy of Combating Climate Change** (NPCCC) has been formulated to outline plans that enhance Samoa's response to climate change and is intended to strengthen the linkages between the SDS - the implementation of which is led by MOF, and the work of MNRE which has 'climate change' in its portfolio. It summarises actions on adaptation and mitigation that are being taken.

The **National Greenhouse Gas Abatement Strategy** (NGGAS) offers another detailed plan on mitigation actions and strategies for different sectors and recognises the role of MOF as limited to procurement of fossil fuels and facilitating investments in energy. The linkages between the NGGAS and the SNEP are well established and the overlap is not necessarily problematic; however a consolidation/merging exercise could help improve and inform each of these. The NGGAS identifies and aspires to more indicators in its long list of outcomes while it lacks an overall measurable goal - though the NGGAS seems guided by the goals of SNEP. The NGGAS also delves deeper into renewable energy issues with identification of specific activities associated with biofuel, biomass (ethanol and methane) and ocean wave energy – some of which received little or no specific mention in the SNEP. It also specifically lists financial incentives as a key indicator. It seems the NGGAS is a more detailed and comprehensive action plan but it is not clear if the NECC, which is linked to SNEP, will take responsibility for any of the deliverables identified under the NGGAS.

Areas where updated strategies and plans could more strongly incorporate LCDS elements

Some gaps, overlaps and improvements to sectors which have been discussed, are noted in the above discussion. One of the key sectors that was not discussed and does not seem to have strong policy linkages to the energy framework is Tourism. Even though this is already a sector that is presumed relevant as a key energy user/stakeholder, establishing a stronger link in the policy framework will give ownership to the largest sector.

Low carbon development stays true to the principles of sustainable development but with the 'X' factor of less carbon in growth. Therefore, it is not to be seen as just about energy use and the involvement of all sectors at different levels can be useful in ensuring wide ownership of the

[34] Samoa's total land area is about 285,000 ha. More than 170,000 ha is categorised as forest areas. These consist of around 45% of Upolu Island and 69% of Savai'I Island. S2NC, p 20

'green' narrative which the GOS is trying to establish. The SDS encourages investment in tourism and offers a legislative framework that incentivises hotel development[35] and this has coincided with high growth in that sector. Being able to grow with 'low carbon' avoids getting locked into a carbon-intensive system that will be more costly to change later.

With reviews of the SDS and SNEP approaching, this presents some key opportunities to review and reassess some of the goals they have set in the energy area which are likely to be lagging behind the enthusiasm in the private sector, especially given advancements that are happening in the area of renewable energy technologies applicable to the Samoa national circumstance.

Core agencies and stakeholder groups

Choosing to aspire towards a low carbon economy is considered a whole of government approach and thus requires the participation of all stakeholders that have an interest in Samoa's sustainable development.

Developments in the Energy Sector seem to have forged a path forward for energy issues, including institutional arrangements that have come about to aid this. In particular, the establishment of a cross sectoral high level coordinating unit (the NECC) is a positive indication of public sector leadership. Ownership and leadership on these issues are not however confined to the four primary stakeholders who are members of the NECC (MOF, MNRE, MWTI, and MAF) and it is vital that this group strives to give ownership and incentivise the 'taking ownership' of 'low carbon initiatives by SOEs (e.g. SROS, STEC and EPC), private sector, civil society, community leaders and all other stakeholders that the Government is best placed to identify.

General conclusions and insights

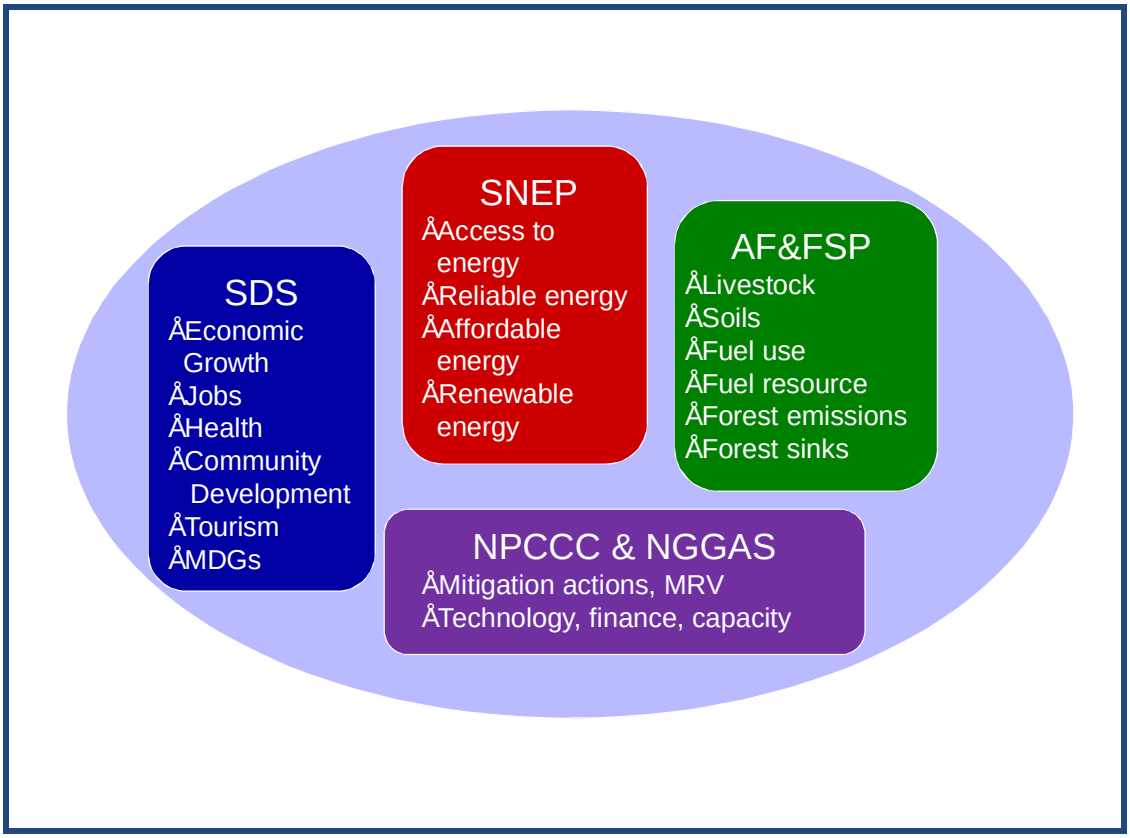
The initial mapping exercise undertaken in this report makes it clear that there already are a significant number of strategies, plans and policies of the Government of Samoa that incorporate elements touching on "low carbon development". However, this has not happened through a conscious or coordinated effort, per se.

But this does not argue for the beginning of a new process to develop a "low carbon development strategy and plan". Rather, it suggests the approach to a low carbon future can be through recognising the strengths that already lie in the existing strategies, plans and policies, and as well noting and addressing the weaknesses and gaps. In particular, as the key strategies, plans and policies tend to be living and dynamic documents, there will be ongoing opportunities to update and strengthen these and, in doing so, improve the awareness, consistency, coordination and ownership of a low carbon "ethos".

Figure 3 below provides a graphical depiction of what we mean by a mainstreaming approach to low carbon development in Samoa. The bullet points in the various process boxes begin to draw out where linkages with low carbon development can be made.

[35] P51 SDS

Figure 3. Mainstreaming low carbon development through Samoa's existing strategies, plans and policies



This issue is further taken up in Section 6 which discusses a process means by which this low carbon mainstreaming could be initiated.

Section 4. "Carbon Neutral Economy by 2020" – Is this a helpful core driver of mitigation action?

Definitional issues

The term "carbon neutral" has no particular definitional meaning (or usage) in the UNFCCC. Measurement and reporting of "anthropogenic emissions by sources and removals by sinks" are undertaken by countries pursuant to national inventory guidelines. One interpretation of carbon neutral could therefore be if a country's net emissions were zero or negative (i.e. removals exceeded emissions). Under this interpretation, Samoa might already claim to be carbon neutral based on the assessment in its Second National Communication to the UNFCCC that Samoa was a net sink (of about 430 kT CO_2) in 2007 – albeit this assessment was made on the basis of forest inventory values that were identified as having potentially high uncertainties and that needed confirmation by more rigorous inventory work[36].

However, applying this definition of carbon neutral at a country-wide level would not be well supported by the experience of the use of the term in the circumstances and markets where it is commonly applied. The terms carbon neutral and carbon neutrality are mostly used in what can be seen as the "voluntary space". This space is typified by companies, organisations and individuals that are trying to show they are taking a leadership role in addressing climate change. This can be as part of "corporate social responsibility" (CSR) initiatives, carbon footprint disclosure (e.g. as part of supply chain carbon footprint assessments and labelling schemes) and for the certification of carbon neutral products and services.

This voluntary space is predominantly a private sector space.[37] It has been quite contentious, with claims (especially in the UK) of "carbon cowboys" (normally associated with the generation and trading of carbon offsets) and "greenwash" (regarding claims of carbon neutrality or low carbon footprints). In September 2009, the UK Government's Department of Energy and Climate Change (DECC) issued a "Guidance on carbon neutrality". In this the definition used for carbon neutral is:

> "Carbon neutral means that – through a transparent process of calculating emissions, reducing those emissions and offsetting residual emissions – net carbon emissions equal zero."

The issue of "offsetting" is therefore a core part of the concept of carbon neutrality. This raises another series of definitional issues and, often, contentious debate. But one area where there has been general consensus is that offsets should pass the test of additionality – i.e. that the actions were not just happening, or going to happen, anyway in the business-as-usual (or reference) scenario.

The relevance of applying these general principles and practices around carbon neutrality to the Samoa circumstance, and its "carbon neutral economy by 2020" goal, include:

- Similarly to a private sector company, Samoa is making this voluntary 'commitment' for the purposes of showing leadership in the international community. It therefore can be expected that Samoa's performance will be scrutinised and that it will be held to high standards by others in the international climate change community (other governments and NGOs).

[36] The JICA funded Forest Conservation and Monitoring project, currently underway, is expected to provide more accurate data on emissions and removals in the forest sector.
[37] However, there is some activity internationally at the local and regional government levels.

- The focus, in the first instance, is on emissions. A boundary (that delineates what is in, and not in, the accounting system) would need to be established for what is seen as the Samoa "economy" and the emissions within this boundary measured and be reduced (and continually measured over time). Against these emissions would be activities that occur outside the boundary and are considered to meet the normal standards of acceptable offsets. This would include activities that enhance sequestration by sinks, i.e. removals that are additional to what is happening or would happen anyway. This is a quite different accounting than for UNFCCC inventories, i.e. "anyway" removals by forests would not be included in what would be considered to be an acceptable emissions offset.
  In short, Samoa would not be seen to be carbon neutral, even if subsequent assessments of the removals by its existing forests showed it to still be a net sink for UNFCCC inventory purposes.
- It is not possible to create offset credits from mitigation activities occurring within the boundary and sell these to external voluntary or compliance carbon markets. This would have the effect of higher emissions occurring elsewhere.
  So Samoa cannot finance reductions inside the boundary through generating and selling credits through the CDM or voluntary markets.

Redefining the carbon neutral goal

Given these definitional and reputational issues and challenges, Samoa should consider the merits of drawing a tighter and clearer, so more meaningful, boundary to its committed goal. We recommend consideration of a **NAMA Programme** to achieve a **Carbon Neutral Energy Sector by 2020.** By taking a broad perspective of "energy sector" and considering (inward) offsets in the land-use and forest sectors, the accounting boundary (within the geographic boundary of Samoa[38]) for the assessment of overall net emissions could cover:

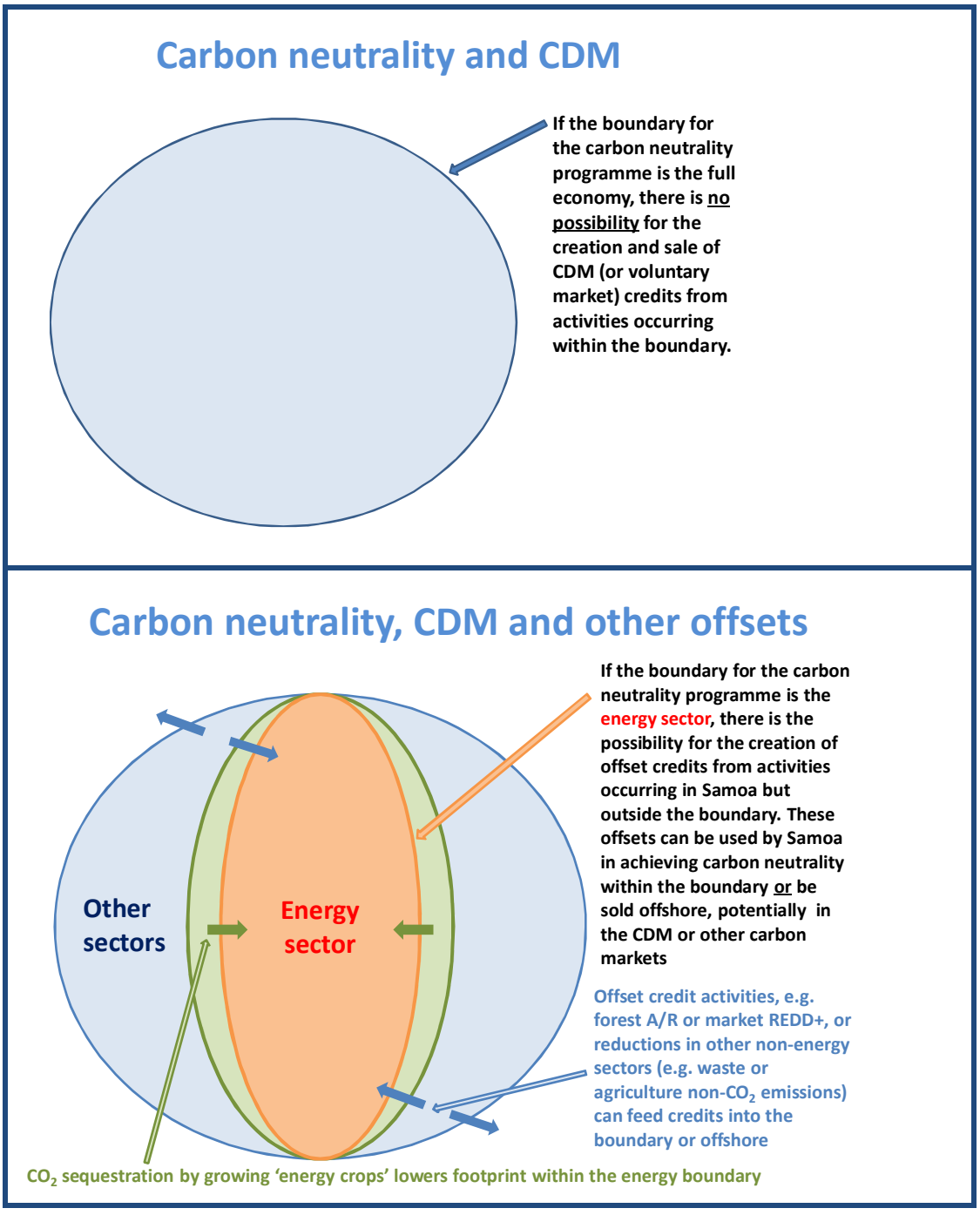
- the core Energy sector (electricity, thermal energy, transport)
- the energy role of Forestry and Agriculture sectors, e.g. full cycle accounting of the provision of biomass-energy feedstocks (so sequestration of CO_2 by the feedstocks as they grew)
- the Forestry and Agriculture sectors as they relate to carbon sequestration offsets, e.g.
  - new afforestation/reforestation and including adaptation measures (such as expansion of mangroves for coastal protection)
  - enhancing soil carbon through organic farming and agroforestry methods, and biochar
- other offset activities in the Forestry and Agriculture sectors (e.g. addressing methane and nitrous oxide emissions), and in other sectors, e.g. the waste sector.

In our view, drawing such an accounting boundary for the carbon neutral goal versus an "economy wide" boundary would be beneficial in a number of ways. It would be clearly delineated, so remove the uncertainty of imprecise (and potentially controversial) definitions and the reputational risks this entails. It would be seen internationally as a significant commitment, showing that Samoa was taking a leadership position in the international community. It would keep the issue of existing forests, and all the uncertainties around the measurement of the net

[38] However, see the discussion on Pg 22 about the upstream footprint of imported biofuels which may add to the Samoa footprint.

removals or emission of these forests outside the boundary.[39] Figure 4 provides a graphical depiction of the main points made above about the connection between carbon neutrality boundaries and offsets.

Figure 4. Carbon neutral boundaries and generating 'offsets' from mitigation activities in Samoa



[39] This also has the benefit of not creating a perpetual commitment to the high costs of maintaining data for these forests at the higher levels of rigour needed for the measurement of the carbon footprint within the 'carbon neutral' boundary. Moreover forests cannot be relied on to be a perpetual sink. In time, sequestration slows and they become just a reservoir of carbon. Also note that these forests could still provide offsets for use within the boundary, e.g. for activities that enhanced net carbon stocks compared with some reference level of stocks (so REDD+ type activities). And the option of external (international) carbon market-based support would also be open, whereas this is not feasible for activities within a carbon neutral boundary.

Section 5. A "NAMA Programme" for a carbon neutral energy sector by 2020

Achieving this goal

In developing such a NAMA – prior to presenting it to the international community, registering it and seeking any technology, financial and capacity building support for needed its implementation and outcomes – it will be important to do a careful assessment of the feasibility of meeting this carbon neutrality goal and the challenges likely to be faced in practice.

This should start with an assessment of the key sources of emissions in the core energy sector and the means to reduce these. An initial readout on this can be seen from the emissions inventory set out in Table 3 below, excerpted from the S2NC.

Table 3. GHG emissions from the energy sector, kilotonnes (kT) CO_2e, 1994 - 2007.

Source	1994	2000	2007	% Change since 1994	% Change since 2000
Electricity Generation	8.82	28.96	44.21	401%	53%
Manufacturing & Construction	-	12.48	16.30	-	31%
Domestic Aviation	0.06	0.06	0	-100%	-100%
Road Transportation	68.93	84.23	95.02	38%	13%
Domestic Shipping	2.24	4.22	5.51	146%	31%
Commercial & Institutional	1.17	0.93	1.39	19%	50%
Residential energy use	11.20	7.47	6.22	-44%	-17%
Fishing	10.40	4.39	5.70	-45%	30%
TOTAL	**102.83**	**142.74**	**174.35**	**70%**	**22%**

Details in the S2NC allow some further break down, in particular of the key fossil fuels and sources that underlie the energy sector inventory values in 2007:

- Electricity generation: Diesel 44.21 kT
- Transportation (approximate values): Unleaded petrol 60.5 kT; Diesel 42.0 kT
- Residential(approximate values): Kerosene 3.7 kT; LPG 1.4 kT
- Commercial: LPG 1.39 kT

It can be seen that, of these sources, the largest portion of emissions comes from the use of diesel. Achieving the carbon neutral objective could therefore, in large part, be achieved by a proactive **"Get Off Diesel"** plan, replacing this, for example, with Samoa-derived renewable fuels. Beyond the benefits to Samoa's carbon footprint, this should also have major economic benefits. Imported diesel is a major cost to the Samoa economy. The typical retail cost of electricity in 2011 of around SAT 0.75/kWh for households and 0.90/kWh for businesses, while not uncommon for Pacific Island countries where diesel generation is prevalent, is much more expensive than that in developed countries in the region, e.g. New Zealand ~SAT_{eq} 0.44/kWh and Australia ~SAT_{eq} 0.52/kWh.[40] This impedes development.

Another key point about the diesel data is that a large amount of this is used in stationery power facilities. If this diesel generation were to be replaced with a "negative emissions" technology such

[40] For New Zealand ~NZ$0.24/kWh at exchange ~0.55 NZ$/SAT; For Australia ~A$0.22/kWh at exchange ~0.42A$/SAT

as biomass gasifiers (using domestic grown biomass) with algae CO_2 sequestration, the 44 kT CO_2 positive emissions could (as a first order notional estimate) become minus 44 kT.

With respect to the emissions in other sectors:

- Transportation: There are vehicle conversion technologies and renewable based fuels (from coconut oil and other biomass) that could lead to high market penetration rates of biodiesel and bioethanol. (Notably, there already are some pilot scale operations in the private sector and SROS has an active research programme for both biodiesel and bioethanol..... see Figures 5.1, 5.2 and 5.3).
- Residential and commercial: There are biodigester technologies (utilising biomass and waste) that could provide biogas to replace kerosene and bottled LPG (e.g. see Figure 5.4).
- Other sectors (manufacturing and construction, domestic shipping, fishing): There are likely to be bio-based alternatives to the main fossil fuels (liquid and gas) used in these sectors.

Figure 5.1. Biodiesel pilot plant at SROS

Figure 5.2 SROS vehicle running on biodiesel

Figure 5.3 Filling up on biofuel from coconut oil

Figure 5.4 Biodigester at YWAM

Providing cooking and lighting energy and fertiliser for community garden from animal, human and green waste.

Bioenergy issues – accounting, sources and technologies

At a first look, therefore, the objective of a **carbon neutral energy sector by 2020**, given the boundary and offset description in Section 4, seems readily feasible. Such a plan, however, relies heavily on bioenergy technologies (e.g. biofuel generators, biomass gasifiers and generators, fuel

switching to biodiesel and bioethanol, and "waste to energy" biodigesters at commercial and household/community scale) and the use of domestic biomass and waste feedstocks. Importantly, growing of bioenergy crops plus carbon capture technologies (such as algae-based CO_2 sequestration systems) and carbon storage (such as biochar in soils) can make it feasible for these overall systems to have **negative emissions** in Samoa and be part of rural economy systems.

However, the practicality of all this at the scales needed will have to be researched thoroughly in the development of any NAMA Programme in the energy sector. In particular, while bioenergy technologies are important for Samoa climate change mitigation efforts, the feedstocks must be researched thoroughly, including resource management measures (guidelines, regulations etc) to ensure the feedstocks are grown and utilised sustainably.

An important issue also to watch is that the role of bioenergy in terms of reductions in greenhouse gas emissions can be controversial. In particular, full product cycle assessments in other countries can show bioenergy emissions are higher than the fossil emissions they are replacing, e.g. if palm oil or other biofuel crops are grown on what had been peat forest lands that have been deforested (e.g. in Malaysia and Indonesia), or the agricultural fertiliser and diesel emissions in growing biocrops are taken into account (e.g. in the United States). There has been widespread international discussion and media attention about such circumstances and a growing NGO-led backlash to the use of bioenergy in developed countries with consequences of GHG emissions and other ecosystem, environmental and social problems in developing countries. Importation of feedstocks therefore should be discouraged wherever there may be negative biodiversity and food security impacts where they are produced.

In short, there are perception risks to be understood, and as well the specific national circumstances of application in Samoa, if the use of bioenergy is a core part of an effort intended to show Samoa is taking a leadership role and enhance its international reputation.

An important technical point is that a perspective (which is not uncommon) that bioenergy is inherently emissions neutral is not correct. This perspective has perhaps grown out of the UNFCCC inventory reporting methodology, based on guidelines from the Intergovernmental Panel on Climate Change (IPCC), whereby the CO_2 emissions from the combustion of biofuels, for example in woody biomass heat and power plants, is taken to be zero. But this is not because of any default position involving the historical sequestering of CO_2 by these biofuel sources, e.g. by trees as they grow. Rather it is because of another default assumption in the inventory guidelines that all above ground carbon in the trees was instantly oxidised at the point of harvest, so became a CO_2 emission there and then. These emissions are therefore already captured in the "agriculture, forestry and other land use" (AFOLU) section of national GHG inventories. To also include them in the energy sector would be to double count them; hence the zero emissions treatment of bioenergy emissions in national inventories. But this, in turn, has led to the mistaken general view that bioenergy is inherently emissions neutral.

A further key point is that methods used for national reporting of GHG emissions and removals under the UNFCCC are quite different than methods for accounting GHG emissions and removals for the land use, land use change and forestry sector (LULUCF) under the Kyoto Protocol, including for the clean development mechanism (CDM). A removal that may be reported is not necessarily a removal that can create an "offset" for accounting purposes.

Moreover, as noted above, the "carbon neutral world', and its methodologies and standards, primarily exist in the voluntary space outside the UNFCCC world. While there are initiatives underway (e.g. the new GHG Protocol standards for corporate value chain and product life cycle), there is still not a single global standard for the accounting for sequestered atmospheric carbon in bioenergy GHG measurement and reporting.

However, it is reasonable that some general conclusions can safely be taken as a basis to think about the treatment of bioenergy emissions in carbon neutral accounting:

- While upstream emissions occurring in other countries for any imported fuels (whether for diesel or biofuels) would not necessarily be judged as part of Samoa's footprint, if there were any controversies around such upstream emissions, this would present a reputational risk to Samoa's carbon neutral objective.
- As set out in the definition of the accounting boundary for the "energy sector" (in Section 4), the sources of the bioenergy would be treated in the "offsets" category. This implies a requirement to use additionality-based accounting methodologies that use a reference case. In this situation, the reference case would include an analysis of the fossil fuel emissions that would otherwise occur and, as well, the emissions and removals that would otherwise be occurring on the agricultural and forestry land.
- Where CO_2 is sequestered over multiple years (e.g. trees in purpose grown bioenergy plantations), for the emissions that occur when the biomass is combusted to be fully offset by the CO_2 sequestered across the years, the accounting system needs to accommodate the temporal difference between when the removals and emissions happen.

  Therefore, there needs to be a start date to the accounting of a carbon neutral programme. To be credible, this would need to be in the present. Given the additionality requirements of offset accounting standards, it would not be seen as credible to count removals from trees whose existence pre-dated any climate change mitigation policy in Samoa. With a given start date, the offsets can then be based on the lifecycle of the biomass, so match the emissions at the time of combustion with the accumulated removals.

Based on these considerations, Table 4 set out how emissions and removals would be counted (so contribute to the carbon neutral goal) for some specific possible sources of bioenergy and energy systems that Samoa might consider. Note that these outcomes do not consider the additional potential to sequester and store CO_2 emissions, e.g. with algae capture systems on stationary energy sources, which is generally necessary for bioenergy to achieve **negative emissions**– and may be needed for some bioenergy systems just to be zero carbon (as would also be the case for fossil fuels).

Note also that this accounting detail does not include any economic accounting. Where there is no GHG accounting benefit, there may however be large economic benefits to Samoa, e.g. where fuels are domestically sourced and so avoid the importing of expensive fossil fuels.

Table 4. Accounting outcomes for bioenergy sources and energy systems (<u>not including</u> the additional potential to sequester and store CO_2 emissions, so negate combustion emissions, in particular from stationary energy sources)

Source of bioenergy / Energy system	Accounting outcome (in a given year) – in terms of carbon footprint of Samoa
A. Imported liquid biofuel used in diesel generators (or other electricity and/or heat generation systems)	CO_2 emissions generally the same as for diesel, or other fossil fuels, and could be higher if have lower efficiencies. (Also may be reputational risks associated with upstream emissions occurring in country of production.)
B. Use of existing invasive species trees as source of woody biomass for electricity and/or heat generation systems	CO_2 emissions from combustion of biomass count as emissions in the footprint calculation. A full accounting would also consider the changes in CO_2 removals on the land, i.e. the effect on removals of the new (altered) land-use compared with the reference case.
C. Use of purpose grown multiyear woody species from "bioenergy plantations" for electricity and/or heat generation systems Note that whether for a coppicing type species or a rotation harvesting plantation where a portion is harvested and replanted annually, a plantation is capable of delivering a fixed amount of biomass annually, and also maintain a constant average stock of above (and below) ground carbon. This situation is achieved when the annual CO_2 sequestration across the whole plantation is equal to the CO_2 contained in the biomass harvested from the plantation. In practice, where these carbon flows are not equal, a plantation can be a net source or net sink of carbon in a given year (including the harvest carbon).	Could have net CO_2 emissions or net CO_2 removals (negative emissions) depending on the balance of the following four accounting elements: • CO_2 emissions from combustion of biomass count as emissions in the footprint calculation. • CO_2 emissions from transportation of biomass to energy plants (but this may be zero for domestic sourced biofuels and accounting for their full CO_2 removals and emissions lifecycle). • CO_2 removals (emissions) equal to the annual increase (decrease) of above (and below) ground carbon stocks on the plantation land, compared with the reference land use. • Assuming using life cycle accounting from a given start date, can also be an annualised amount of CO_2 removals from the increase in average carbon stocks on the plantation land compared with the reference case.
D. Use of purpose grown annual biocrops for electricity and/or heat generation systems	In general, net CO_2 emissions are zero (CO_2 in combustion emissions has come from CO_2 removed as crops grow). May be non-CO_2 emissions from use of any fertilisers, which if nitrous oxide can result in high CO_2 equivalent emissions. A full calculation also requires looking at the land-use, and net emissions or removals, occurring in the reference case.
E. Bioenergy derived from coconuts or other biocrops, e.g. bio-oils or biodiesel for liquid fuels, and biomass energy from, e.g. husks or other crop waste.	In general, net CO_2 emissions are zero (CO_2 in combustion emissions has come from CO_2 removed as coconuts grow). Will be some emissions for transportation of coconuts and other biocrops to biofuel processing

	plants or bioenergy site (but this may be zero for domestic sourced biofuels and accounting for their full CO_2 removals and emissions lifecycle).
F. Use of biogas derived from waste (animal, human, green waste, etc) using biodigester systems.	Net CO_2 equivalent emissions are calculated from: • CO_2 emissions from the combustion of biogases • minus CO_2 equivalent emissions of methane emissions avoided in the reference case. Depending on the circumstances, e.g. the extent of methane emission in the reference case, the result can be negative emissions. (And note this is before the potential of sequestering the CO_2 emissions from combustion.)

Summing up on bioenergy, because of Samoa's national circumstance, wherein land-based mitigation actions can have the co-benefit of addressing multiple development issues (e.g. energy security, high cost of energy, waste, health, deriving economic value from customary lands, jobs) as well as lead to a dramatic lowering of emissions (to below net zero) and showcase negative emissions technologies, it seems clear that bioenergy and "bio systems" can be expected to play a major role in a low carbon development strategy and an energy system NAMA for Samoa.

The above detail on bioenergy systems is not to suggest that other "traditional renewables" such as wind, solar or small scale hydro may not also play a role in a plan for a carbon neutral energy sector by 2020. **All renewable technologies should have the opportunity to compete on an equal footing within an assessment framework that takes a comprehensive low carbon development perspective including co-benefits.**

It is noteworthy, however, that these other renewable technologies do not provide a pathway to negative emissions. While it can be argued that, in the case of bioenergy, the negative comes from the growing of biomass, not its use as energy per se, the question would need to be asked what is the biomass going to be used for, if not for energy. In other words, if the biomass were not being grown for its uses in quick rotation bioenergy applications, what is the alternative economic story for it to be grown at all? **Any significant use of other non-biomass renewables would therefore limit the potential scale of negative emissions outcomes in the energy sector.**

Elements of a NAMA Programme in the energy sector

In preparing a NAMA programme along the lines suggested here, it should be seen as something that serves national, Pacific regional and international purposes. The **national purpose** connects to the importance of "low carbon" to be an infused element in all Samoa's strategic planning documents that touch on development and the energy sector.

Undertaking the preparation of the programme needs to be a multi-stakeholder exercise involving all core ministries and key public bodies, and other important non-governmental institutional, private sector and community groups. Given the potential for transformational change that can come out of this exercise, it needs to be an enthusiastic and energetic process that all stakeholders feel they have been able to provide input into and can take ownership of its outcomes.

The **Pacific regional purpose** is that Samoa can be a showcase for technologies, systems and governance and stakeholder processes that can have wide application throughout the region.

The **international purpose** connects to

1. Samoa's interest to be seen as a leader in climate change affairs and advocate for global emissions pathways that take seriously the interests of Samoa and other SIDs; and
2. the need for Samoa to set out a coherent and comprehensive NAMA that clearly articulates any needs for support from the international community for technology, finance and capacity building – as requested in the Cancun Agreements.

The elements of the NAMA (some of which has received an initial framing in this document) could generally follow an outline of:

- A **Carbon Neutral Energy Sector** by 2020
  - Definition of carbon neutral
    - Emissions boundary (what is included and what not)
    - Offset elements (including treatment of temporal issues for CO_2 sequestration)
- How feasible and challenging is this carbon neutrality goal likely to be in practice for Samoa?
  - Initial assessment from current emissions inventory and projections
  - Issues/challenges for technology transfer and financing
- Importance of "Get Off Diesel" plan – carbon footprint and economic implications
- Potential role (including economics) of biomass-based systems and technologies, including "negative emissions" elements
  - Biofuel generators
  - Biomass gasifiers and generators
  - Fuel switching in the transport sector – biodiesel, bioethanol and compressed biogas
  - Algae-based CO_2 sequestration (CO_2 scrubbers)
  - Biochar
  - Biodigesters ("waste to energy" at commercial and household/community scale)
  - On-island production of bioenergy feedstocks in agriculture and forest sectors
- Potential role (including economics) of other renewables – wind, solar, hydro, wave, geothermal, ocean thermal energy conversion (OTEC)
- Identification of other environmental, social and economic co-benefits, including achievement of Millennium Development Goals (MDGs)
  - Increased uptake of adaptation strategies by communities
  - Effects on land productivity
  - Increased job creation and upskilling
  - Waste reduction (including health and sanitation benefits)
  - Lowering of energy costs – to households, businesses and national accounts
    - through domestic renewable energy and gains to energy system efficiencies
  - Deriving economic value from customary lands
  - New opportunities for private sector, in Samoa and regionally

- Identification of potential dis-benefits (e.g. competing uses for land)
- Regulatory processes
    - How the government plans to implement the programme, including environmental impact assessments, social impacts, etc
- Financial and Investment issues
    - Costs of identified most-suitable technologies – initial capital and ongoing operation and maintenance
    - Sources of finance and access
        - domestic and international
        - public and private
    - Possible role of feed-in tariffs for independent power producers for different technologies and footprint outcomes, including assessment of scale and source of needed support
- What international support is needed for such a NAMA Programme?
    - Technology
    - Finance
    - Capacity Building

Section 6. Process forward on LCDS and NAMAs

LCDS

Building from the discussion in Section 3, we see a low carbon development strategy and plan for Samoa as not something (or some things) that are new stand alone efforts. Taking such a top-down approach would, in our view, lose valuable time and struggle to achieve the multi-stakeholder ownership we believe is crucial for success.

Instead, we consider that a more bottom-up process could be effective. Such a process would seek to infuse the low carbon "ethos" into relevant sections of existing strategies and plans right across government. And it would make clear how taking a low carbon approach, including measures of a NAMA programme in the energy sector, can produce very beneficial outcomes on issues that might otherwise seem to have nothing to do with climate change, e.g. how waste to energy systems can link with lowering infant mortality and respiratory illnesses, or how new opportunities for jobs and economic activity from growing energy crops on customary lands can lift rural community incomes.

In particular, the fact that both the Samoa Development Strategy and the Samoa National Energy Policy are about to go through updates provides a perfect opportunity to create this integration with low carbon and an energy sector NAMA. Indeed, missing this opportunity could set back Samoa's potential to meet any carbon neutral goal.

One possibility would be that a well designed and facilitated workshop is conducted in the near term with the explicit intent to have participants draw out the links between existing strategies and plans with low carbon and an energy sector NAMA, so begin this infusing and ownership process. Our preliminary analysis and thinking in Section 3 can help provide the beginnings of an information resource base (and justification) for such an approach. Such a workshop ideally would involve all relevant core ministries and key public bodies, and other important non-governmental institutional, private sector and community groups. It might also include representatives of key donor groups active in Samoa as observers.

NAMA Programme in the energy sector

Whereas we do not see a LCDS as a separate standalone effort or document, the NAMA is a specific product that will, in time, need to be fully elaborated and registered with the UNFCCC. This should be developed in parallel with the low carbon effort, as there are obvious and clear linkages. These need to be coherent and consistent.

On process, we think the workshop suggested above could be a common launching pad. Following this, given the necessary funding, the exercise to develop the NAMA could move forward quickly with a view to Samoa being ready in early-mid 2012 to register it with the UNFCCC NAMA Registry.

General communication on this work effort at international events in 2012

There are a number of opportunities in 2012 to update the international community on the work on these low carbon development and NAMA fronts. Samoa could:

- provide general status updates at upcoming sessions of the Cartagena Dialogue
- make a presentation at "Earth Summit 2012" (Rio+20) in Rio de Janiero in June 2012