Platform Groene Grondstoffen

Roadmap duurzame biomassa import

Uitwerking van transitiepad 2:
Realisatie van de Biomassa Import Keten

december 2006

Creatieve Energie
EnergieTransitie

Auteur: André Faaij ***(Copernicus Instituut – Universiteit Utrecht)***

Roadmap duurzame biomassa import

Uitwerking van transitiepad 2: Realisatie van de Biomassa Import Keten
Platform Groene Grondstoffen
december 2006

Inhoudsopgave

Voorwoord

Voor u ligt de samenvattende rapportage van de uitwerking van het transitiepad "Realisatie biomassa importketen". In opdracht van het Platform Groene Grondstoffen heeft André Faaij van het Copernicus Instituut in overleg met stakeholders uit industrie, overheid en wetenschap dit transitiepad verder uitgediept: wat is het potentieel van biomassaproductie mondiaal gezien, welke mogelijke duurzaamheidaspecten zijn van belang, onder welke condities kan duurzame import gerealiseerd worden, wat is er aan beleid nodig?

De overkoepelende rapportage van het Platform Groene Grondstoffen "30% vervanging fossiele grondstoffen in 2030" is gebaseerd op de uitwerkingen van de 5 transitiepaden. Ook voor de andere transitiepaden zijn rapportages verkrijgbaar.

1 Achtergrond

1.1 Het platform Groene Grondstoffen en haar doelstellingen

Afhankelijkheid van fossiele grondstoffen vraagt om nieuwe oplossingen
De Westerse wereld is voor haar grondstoffen en energievoorziening momenteel sterk afhankelijk van fossiele grondstoffen. Op drie niveaus brengt die afhankelijkheid risico's met zich mee:
- Ecologie: fossiele grondstoffen zijn niet duurzaam (uitputting, emissies, CO2)
- Geopolitiek: voorzieningszekerheid en leveringszekerheid van fossiele brandstoffen is probleem vanwege afhankelijkheid van politiek instabiele regio's
- Economie: fossiele grondstoffen zijn duur
- Economie: specifieke Nederlandse sterktes bieden unieke kansen voor NL bedrijvigheid (kennis op gebied van havens, chemiecluster, landbouw en logistiek)

Deze risico's vragen om nieuwe oplossingen. Echte overgangen –transities- naar nieuwe systemen zijn nodig. Daarom hebben regering en overheid zes platforms energietransitie opgericht. Deze platforms komen met voorstellen voor een duurzame energievoorziening. De platforms bestaan uit experts uit bedrijfsleven, kennisinstellingen, belangenverenigingen en overheid.

Wat doet het Platform Groene Grondstoffen?
Het Platform Groene Grondstoffen adviseert de regering over een toekomst waarin de afhankelijkheid van fossiele grondstoffen (olie) afneemt door het gebruik van groene grondstoffen. Groene grondstoffen kunnen gebruikt worden in de voorziening van elektriciteit, warmte, transportbrandstoffen, chemicaliën en materialen. Het platform heeft de volgende leden:

Ir. Paul Hamm	Voorzitter/ondernemer	Meike Baretta	Greenpeace Nederland
Ger Bemer	Nedalco	Dr.ir. Marjan Botman	Ministerie EZ
Prof.dr. Alle Bruggink	DSM/NWO/RUN	Dr. Peter Bruinenberg	AVEBE
Dr. André Faaij	Copernicus Instituut, UU	Ir. Kees Kwant	SenterNovem
Peter Lednor	Shell	Prof.dr. Emmo Meijer / Dr. Jan Maat	Unilever
Prof.dr. Lucas Reijnders	St. Natuur en Milieu	Prof.dr. Johan Sanders	Wageningen UR
Prof.dr. Wim van Swaaij	Universiteit Twente	Dr. Johan Vanhemelrijck	EuropaBio
Prof.dr. Hubert Veringa	ECN	Prof.dr.ir. Luuk van der Wielen	TU Delft
Ir. Edith Engelen	Secretaris/SenterNovem		

Wat wil het platform Groene Grondstoffen realiseren?
Het Platform denkt de afhankelijkheid van fossiele grondstoffen (olie) aanzienlijk te kunnen terugdringen door het gebruik van op duurzame wijze geteelde en toegepaste groene grondstoffen (biomassa). Groene grondstoffen kunnen binnen 25 jaar tot 30% van de Nederlandse grondstoffen en energiebehoefte dekken.
Groene grondstoffen kunnen na 2030 de basis zijn voor:
- 60% van de transportbrandstoffen
- 25% van de chemicaliën en materialen
- 17% van warmteverbruik
- 25% van de elektriciteitsvraag.

Duurzaamheid
Gebruik van biomassa kan voordelen hebben boven het gebruik van fossiele grondstoffen: biomassa is hernieuwbaar, kan forse reductie van CO2-emissies opleveren, herkomst is niet beperkt tot enkele regio's en 'energieteelt' kan ook in ontwikkelingslanden financiële middelen genereren, die vervolgens verdergaande professionalisering en efficiency mogelijk maken in de conventionele landbouw. Echter, om concurrentie tussen voedsel en energie en degradatie van landbouwgronden te voorkomen zijn voorzorgsmaatregelen nodig. Een snelle wereldwijde toename

van productie en inzet van biomassa brengt mogelijk grote ecologische, sociale en/of economische risico's met zich mee. Dit is de aanleiding geweest voor de overheid om een werk groep in te stellen, die in juli 2006 een eerste raamwerk voor duurzaamheidcriteria voor biomassaproductie (en import) heeft opgesteld. In het eerste kwartaal 2007 zal deze werk groep een verder uitgewerkte protocol voor toepassing van criteria op korte termijn presenteren. Het Platform Groene Grondstoffen onderschrijft de noodzaak van dit traject en de verdere uitwerking van deze duurzaamheidcriteria in politieke kaders op nationaal, Europees en mondiaal niveau. Het platform vindt het ambitieniveau van de criteria spreekt nog wat te bescheiden om de gehoopte voordelen te verwezenlijken.
De biomassa die wij in Nederland willen ontwikkelen, importeren en toepassen, zal op duurzaamheid getoetst moeten worden aan de hand van de opgestelde duurzaamheidcriteria.

1.2 Het Pad Duurzame Biomassa Import

Het Platform Groene Grondstoffen is verantwoordelijk voor het uitwerken van een transitiestrategie voor de grootschalige, duurzame, inzet van biomassa in de Nederlandse energie- en materiaalvoorziening. PGG heeft in haar visie aangegeven dat grootschalige import van biomassa (of energiedragers geproduceerd uit biomassa) essentieel is om het beoogde doel, 1/3 van de energievoorziening in 2040 (ca. 1000 van de beoogde 3000 PJ totaal nationaal verbruik) op basis van biomassa, te halen. Alhoewel er nog discussie en onzekerheid is over het nationale biomassa potentieel, is duidelijk dat voor het halen van dit doel iig meer dan helft en mogelijk tot circa 80% van de beoogde 1000 PJ moet worden geïmporteerd. Dat is equivalent aan ca. 25 tot ruim 40 Mton biomassa per jaar (op droge stof basis). Daarvoor is mogelijk, afhankelijk van de wijze waarop de biomassa wordt geproduceerd, 1 - 4 miljoen hectare land elders nodig (variërend met een biomassaopbrengst tussen 10 en 25 ton droge stof per hectare/jr; 10 ton is haalbaar op korte termijn in NW en midden Europese condities, 25 ton is mogelijk met plantages op goede kwaliteit gronden in tropische regio's).

Voor Nederland is import van biomassa nu al een van de belangrijkste bronnen voor energieproductie uit biomassa, met name door bijstook van geïmporteerde stromen in kolencentrales (zie Junginger & Faaij, 2005). De vraag of deze import op termijn sterk kan worden uitgebreid en of de duurzaamheid daarvan kan worden gegarandeerd is onderwerp van intensief debat, onderzoek en onderdeel van activiteiten van marktpartijen in het veld.

Recente studies tonen aan dat deze eeuw wereldwijd de mogelijkheden voor biomassa productie en benutting in beginsel zeer groot zijn. Biomassa zou door een combinatie van reststromen uit bos- en landbouw, organisch afval en mest (totaal ca. 100 EJ), benutting en herstel van gedegradeerde gronden door biomassaproductie (bv. herbebossing) (totaal ca. 100 EJ) en efficiëntere benutting van landbouwgronden en graslanden (totaal ca. 200 EJ) in ruim een derde van de toekomstige mondiale vraag naar energie kunnen voorzien; dat is een vergelijkbare rol als aardolie nu inneemt. Echter, het beschikbaar maken van gronden zonder te conflicteren van voedselproductie, behoud van biodiversiteit en bossen en realisatie van op ecologisch en sociaal-economisch verantwoorde wijze productie is geen gegeven (zie Appendix I voor een uitgebreider overzicht). Afhankelijk van de biomassastromen, karakteristieken van het productie gebied (ecologisch, landbouw, sociaal-economische ontwikkeling, ontwikkeling van regionale energie- en voedselvraag) zullen tailor-made oplossingen moeten worden gevonden, passend binnen meer universele duurzaamheidcriteria. [zie bv. WWI, 2006, IEA Task 40, IPCC, Hoogwijk et al, Smeets et al., NMP, IIASA, Fritsche et al., etc., van Dam et al., 2006]

Een belangrijk nationaal proces waarvan de 2^{e} fase vroeg in 2007 wordt afgerond, betreft de werkgroep Duurzame Productie Biomassa (DPB, ofwel de Commissie Cramer). In deze werkgroep nemen vertegenwoordigers van de rijksoverheid, markt, NGO's en kennisinstellingen deel om criteria te formuleren tbv duurzame biomassa-import. Het advies van deze werkgroep moet onder meer een kader verschaffen voor de opvolger van de MEP regeling, voor (eventuele) import van biobrandstoffen voor de transportsector en advies formuleren voor vervolgactiviteiten. Deze werkgroep is vooralsnog operationeel tot begin 2007 om diverse criteria, met name voor de korte termijn, een verdere uitwerking te geven.

Het PGG heeft de taak, mede op basis van dit advies, een implementatiestrategie uit te werken voor de lange termijn om grootschalige duurzame biomassa-import daadwerkelijk te realiseren. Op voorhand wordt erkend dat, ondanks de in beginsel grote potentiëlen, duurzame grootschalige

beschikbaarheid en aanvoer van biomassa geen gegeven is. Duurzame productie moet worden gedemonstreerd en geïmplementeerd in zeer verschillende situaties. Bepalende factoren als ontwikkelingen van handelsregimes (voor landbouwproducten, biomassa en biobrandstoffen), efficiencyverhoging in de landbouw en veeteelt en de snelheid waarmee die kan worden behaald in verschillende wereldregio's, demografische trends en economische ontwikkelingen, zijn ten dele onzeker en kunnen ontwikkeling van duurzame biomassaproductie vanuit een mondiaal perspectief negatief en positief beïnvloeden. Biomassa productie kan echter ook een 'hefboom' vormen voor duurzame rurale ontwikkeling (als omschreven in [Faaij & Domac, 2006], door de UNCTAD [Zarilli, 2006] en beoogd in het International BioEnergy Programme (IBEP) van de FAO [FAO, 2006]), door inkomsten te genereren in rurale gebieden waarmee ook weer geïnvesteerd kan worden in (meer) duurzame, conventionele landbouw, infrastructuur en marktontwikkeling. Dit kan zowel leiden tot verbeteringen op sociaal-economisch vlak als duurzamer landgebruik. Biomassaproductie moet nadrukkelijk als onderdeel van een dergelijk ontwikkelingstraject worden gezien en niet op zichzelf staan. Daarnaast zijn er aanzienlijke mogelijkheden biomassa te produceren op marginale gronden (met ecologische voordelen) en efficiënt gebruik van reststromen uit landbouw, bosbouw en organische afvalstromen.

1.3 Doelstellingen

Het hoofddoel van de in dit document beschreven activiteiten is het formuleren van een transitiepad voor het realiseren van duurzame biomassa importketens. Hiertoe zijn de volgende elementen cruciaal:

- Definitie van vereiste activiteiten (onderzoek, demonstratie, technologieontwikkeling), alsmede omschrijving van belangrijke onzekerheden en barrières.
- Opstellen van een tijdpad en inschatting van de kosten (overheidsinvesteringen en marktinvesteringen).
- Betrekken van de belangrijkste actoren in Nederland, inventarisatie van huidige posities en motivatie om bij te dragen aan realisatie van duurzame biomassa importketens. Eveneens afstemming met andere paden binnen PGG en eventueel andere transitieplatforms.
- identificatie van cruciale spelers in het buitenland (marktpartijen, overheden in beoogde biomassaproduktieregio's, kennisinstellingen, internationale organisaties, etc).

Op voorhand wordt erkend dat in dit stadium de duurzaamheid van grootschalige biomassaproductie en import vanuit andere werelddelen op dit moment niet structureel kan worden gegarandeerd. Cruciaal voor de activiteiten op kortere termijn is dan ook om meer ervaring op te doen met verduurzaming van biomassa productie- in importketens. Dergelijke ervaring zou de fundering moeten leveren voor verdere opschaling op middellange termijn.

Dit document schetst een roadmap voor de ontwikkeling van duurzame biomassa-importcapaciteit in de tijd, vooral (maar niet exclusief) bezien vanuit nationaal perspectief. Het betreft een discussiedocument dat is opgesteld met betrokkenheid en consultatie van voor Nederland cruciale stakeholders (zie sectie 1.4). Deze betrokkenheid gold met name voor het opstellen van de contouren van een programma voor demonstratie van duurzame biomassaproductie op kortere termijn (bv. tot 2014). Verder heeft het Platform Groene Grondstoffen het document gedurende het opstellen van commentaar voorzien en de onderliggende versie geaccordeerd.

1.4 Betrokken stakeholders bij nationaal onderzoeks- en demonstratieprogramma duurzame biomassa import

- Sander van Bennekom - OXFAM-NOVIB,
- Daan Dijk - Rabobank
- Jeroen Douglas - Solidaridad
- Jeanette Hoek - OASE
- Barbara van den Hoek - WNF
- Gerry van der Ven, Martin van Ittersum – Sectie Plantaardige Productiesystemen PPS, WUR
- Peter Jansen - PROBOS
- Helma Kip - Essent-Strategy
- Peter Kwant - Shell International, Hans Peter Calis - Shell Gas & Power
- Marc Londo, Andre Wakker - ECN – beleidsstudies.
- Johan Maris - Control Union Certifications BV
- Marieke Meeusen – Landbouw Economisch Instituut (LEI)

- Ger Ostermeijer - Peterson
- Wijnand Schonewille, Ronald Backers - Havenbedrijf Rotterdam
- Peter Paul Schouwenberg, Alf van Weereld - Essent Energy Trading
- Angelika Voss, Iris Lewandowski - Shell Global Solutions,

Leden van het Platform Groene Grondstoffen:
- Paul Hamm, Voorzitter PGG
- Marjan Botman, EZ
- Ger Bemer, Nedalco
- Peter Bruinenberg, AVEBE
- Alle Bruggink, DSM/NWO/RUN
- Edith Engelen, Secretaris PGG - SenterNovem
- Kees Kwant, SenterNovem
- Peter Lednor, Shell
- Emmo Meijer/Jan Maat, Unilever
- Johan Sanders, Wageningen UR
- Wim van Swaaij, UT
- Johan Vanhemelrijck, EuropaBio
- Hubert Veringa, ECN/TU Twente
- Luuk van der Wielen

2. Ontwikkeling van internationale markten voor biomassa en bio-energie

De vraag naar energie blijft de komende decennia sterk groeien. De huidige 450 EJ primair mondiaal energiegebruik zal naar verwachting zijn verdubbeld rond het midden van deze eeuw. Elektriciteit en transportbrandstoffen zijn de belangrijkste 'groeiers'. Tegelijkertijd moeten broeikasgasemissies sterk worden gereduceerd om klimaatverandering binnen redelijke grenzen te houden. Biomassa is, mits duurzaam geproduceerd, nagenoeg CO2 neutraal en kan zowel voor productie van elektriciteit en warmte, transportbrandstoffen als feedstock (en bouwmateriaal) worden gebruikt. Bovendien zijn diverse toepassingen al concurrerend (ethanol uit suikerriet, warmte en krachtproductie uit biomassa reststromen, bv. middels bijstook in kolencentrales) met fossiele alternatieven. De potentiële vraag naar biomassa voor die verschillende markten is groot (zie onder meer IPCC 4th Assessment Report, 2007). De mondiale productie van biobrandstoffen is in enkele jaren tijd verdubbeld van ca. 0,5 naar ruim. 1 EJ op dit moment, vooral gestimuleerd door de hoge olieprijzen. Ook de groei van elektriciteitsproductie uit biomassa is sterk, zeker in de Europese Unie.

Gegeven de sterk toenemende vraag naar transportbrandstoffen, (verwachte) beperkingen in de aanvoer van goedkope, conventionele oliereserves in de komende decennia en de concentratie van die reserves bij een beperkt aantal olie-exporteurs maken met name biofuels een interessante toepassing van biomassa. Op kortere termijn zijn elektriciteit en warmte echter de belangrijkste toepassingen. Gebruik van biomassa als CO2 neutrale feedstock voor de (chemische) industrie kent vele toepassingsroutes die op termijn een belangrijke (extra) vraag naar biomassa kunnen creëren (zie van [Sark et al., 2006] en [Hoogwijk et al., 2003]), maar deze markt is tegelijkertijd omgeven met meer onzekerheden [IPCC, 2007].

De internationale handel in biobrandstoffen groeit snel. Handel in vaste brandstoffen, zoals chips, residuen en pellets is d afgelopen jaren ook sterk gegroeid. Data hierover zijn echter schaars. Wat betreft biobrandstoffen zijn recent reviews opgesteld door WWI en UNCTAD (zie appendix IV voor een samenvatting).
Markten zijn door de bank genomen niet transparant en onderontwikkeld en diverse barrières hinderen verdere ontwikkeling. Handelsstromen zijn matig in kaart gebracht en er is beperkt statistisch materiaal, model- en marktanalyses beschikbaar.

In sommige markten zijn prijsstijgingen van biomassa resources en biofuels zichtbaar, inclusief indirecte effecten op de prijzen van grondstoffen voor bijvoorbeeld de papierindustrie en suiker. Biomassa markten zijn nog kwetsbaar en dat geldt in het bijzonder voor de vraagkant. Veel markten, bv. voor vaste brandstoffen zijn nu afhankelijk van overheidsdoelstellingen en incentives. Beleidsprioriteiten en de mate waarin financiële instrumenten worden ingezet (zoals subsidies) wijzigen echter veelvuldig (zie voor een meer gedetailleerde analyse o.a. [IEA Task 40[1], 2006: www.bioenergytrade.org en [Zarilli, 2006])

Belangrijke drivers achter internationale handel in biomassa aan biofuels zijn:

- Voorzieningszekerheid: biomassa vergroot het portfolio primaire brandstoffen. Daarnaast is biomassa beschikbaar in veel verschillende wereldregio's en meer evenwichtig verspreid vergeleken met fossiele brandstoffen. Voor biomassaprojecten als zodanig betekent verminderde afhankelijkheid van regionale resources ook lagere risico's).
- Kosten: veel biomassa resources elders in de wereld zijn goedkoper dan biomassabronnen binnen Nederland, ook inclusief internationaal transport.
- Ontwikkeling; biomassa kan een significante impact hebben op economische activiteit en werkgelegenheid in rurale economieën.
- Milieu: effectieve reductie van broeikasgassen en efficiënt gebruik van natuurlijke hulpbronnen, met name indien biomassa productie leidt tot beter beheer van land en wordt gebruikt om ecologische voordelen te behalen zoals bodemverbetering.

Het is vooral van belang dat zowel vraag als aanbod van biomassa (en daarvan afgeleide energiedragers en in het bijzonder biobrandstoffen voor transport) zich op een gebalanceerde wijze ontwikkelen. Verstoringen en instabiliteit kunnen investeringen in biomassaproductie, infrastructuur en conversiecapaciteit bedreigen, wat funest is voor verdere ontwikkeling van de markt. Inzichten in hoe dat in de tijd optimaal kan worden georganiseerd zijn op dit moment beperkt.

In diverse arena's is fel debat over de duurzaamheid van grootschalig gebruik van biomassa en internationale handel. Er zijn verschillende perspectieven en strategieën over hoe biomassamarkten zich (zouden moeten) ontwikkelen en hoe de duurzaamheid daarvan moet worden gegarandeerd (bijvoorbeeld middels certificering, zie ook appendix III; [van Dam et al., 2006]). Garanties dat biomassa die in andere delen van de wereld wordt geproduceerd ook duurzaam is vereist dat criteria wereldwijd middels monitoring en verificatie worden nageleefd. Daarvoor is draagvlak bij de betrokken stakeholders cruciaal, alsmede op internationaal niveau.

Tegelijkertijd is het essentieel dat certificering in zichzelf geen barrière wordt voor handel. Juist een open markt bevordert dat resources beschikbaar komen en er geïnvesteerd wordt in nieuwe (conversie) capaciteit. Als gezegd zijn biomassamarkten onderontwikkeld en kwetsbaar en er een diversiteit aan barrières die efficiënte handel hinderen (zie appendix II voor een overzicht).

Uiteindelijk kan biomassa zich ontwikkelen in een commodity markt (de internationale bio-ethanolmarkt is momenteel het verst ontwikkeld). Dit kan belangrijke voordelen hebben, zoals verbeterde marktstabiliteit en concurrerende prijzen. Maar de duurzaamheid van grootschalige biomassaproductie en handel moet worden gegarandeerd. De 'governance' van biomassa en biofuel markten bevind zich nu op een kritisch punt. Er kunnen nog fundamentele keuzen gemaakt worden hoe biomassamarkten zich uiteindelijk vormen en hoe ze kunnen worden beïnvloed en gecontroleerd.

De sterk stijgende vraag naar biomassa van de afgelopen jaren heeft internationale handel sterk gestimuleerd. Deze handel heeft het perspectief op biomassa ook veranderd van primair een regionale energiebron naar een mondiale commodity. Nederland is in die ontwikkelingen (slechts) een van de spelers, maar wel met een sterke koploperpositie.

[1] *IEA Task 40 'Sustainable International Bio-energy Trade'* is een netwerk, onder de Bio-energy Agreement van het International Energy Agency, wat zich bezighoudt met overzicht krijgen over ontwikkelingen analyses en organiseren van uitwisseling en dialoog mbt internationale biomassa markten en handel. Dit netwerk heeft momenteel representanten van 10 landen (Brazilie, Belgie, Canada, Duitsland, Finland, Italie, Nederland, Noorwegen, Verenigd Koninkrijk, Zweden, FAO en de Wereldbank. De coordinatie wordt verzorgd door het Copernicus Instituut van de Universiteit Utrecht en Essent Energy Trading. SenterNOVEM treedt op als 'Operating Agent'.

3. Duurzaamheid van biomassa

3.1 Werkgroep Duurzame Import Biomassa

Zoals gesteld is het een hoofddoel van het PGG en de ontwikkeling van grootschalige duurzame biomassaproductie en importcapaciteit het garanderen van de duurzaamheid daarvan. Daarbij dient concrete invulling te worden gegeven aan het advies van de werkgroep Duurzame Productie Biomassa ('Commissie Cramer'). Hieronder zijn de hoofdconclusies van het advies opgenomen. Uit: [DPB, 2006]:

Algemeen

Biomassa biedt grote kansen voor de transitie naar een duurzame energiehuishouding. Een snelle wereldwijde toename van de productie en inzet van biomassa brengt echter mogelijk grote ecologische, sociale en/of economische risico's met zich mee. Daarom pleit de projectgroep voor een zorgvuldige ontwikkeling van de inzet van biomassa voor energie, transport en chemie. Zodoende kan bijtijds worden bijgestuurd indien ongewenste effecten optreden. Het is daarnaast van belang om de positieve effecten van biomassa te benoemen. Energieteelt kan financiële middelen genereren die verdergaande professionalisering en efficiency mogelijk maken in gebieden met conventionele landbouw. Dat is essentieel om op termijn concurrentie tussen biomassa voor voedsel, energie en feedstock, alsmede degradatie van landbouwgronden, te voorkomen. In dit kader is het van belang dat de Nederlandse overheid samen met andere EU landen het initiatief neemt in het opzetten van nationale en/of mondiale monitoringprogramma's om negatieve effecten tijdig te kunnen onderkennen.

De projectgroep heeft geen standpunt ingenomen over het gebruik van Genetisch Gemodificeerde Organismen (GGO's). De standpunten omtrent GGO's zijn verdeeld, ook in de projectgroep, en de discussie hierover gaat het werkterrein van de projectgroep te buiten. In de toekomst kan voor biomassaproductie worden aangesloten bij de uitkomsten van de discussie die rondom voedsel wordt gevoerd.

Voor een transitie naar grootschalig gebruik van biomassa voor energie, transport en chemie zijn verbeteringen in de conventionele landbouw noodzakelijk. Een verbetering van de landbouw efficiëntie is een vereiste om concurrentie met voedselproductie te vermijden. Dit betekent tevens een kans voor de conventionele landbouw. De biomassamarkt biedt (financiële) mogelijkheden om in te zetten op verbeteringen in landbouw. Dit kan gestuurd worden door op termijn de duurzaamheideisen voor de productie van biomassa aan te scherpen.

De projectgroep heeft duurzaamheidcriteria ontwikkeld voor biomassa voor chemie, transportbrandstoffen en energieopwekking. Deze zijn opgenomen in de aparte textbox in deze sectie. Food, feed en fuel kunnen echter moeilijk afzonderlijk worden bezien. Het is belangrijk dat op termijn ook duurzaamheidcriteria worden ontwikkeld voor voeding en veevoer, om verdringingseffecten te voorkomen.

Vertaling in beleidsinstrumentarium

Een zorgvuldige vertaling van de duurzaamheidcriteria in beleidsinstrumenten is essentieel. Hierbij is een overgangsfase nodig voor bestaande contracten voor transportbrandstoffen. In het geval van de MEP geldt dat reeds bestaande beschikkingen niet zullen worden opengebroken.

Bij inpassing in het beleidsinstrumentarium verdient het de voorkeur om de subsidie in het kader van de MEP en de meetelling in de verplichting biobrandstoffen afhankelijk te maken van de mate waarin broeikasgasemissies zijn gereduceerd. Deze differentiatie betreft alleen de broeikasgasbalans en niet de andere duurzaamheidcriteria. Laatstgenoemde criteria zijn minimumeisen waaraan voldaan moet worden.

Naast het financiële instrumentarium is flankerend beleid noodzakelijk om een goede implementatie van de duurzaamheidcriteria te waarborgen. Dit betreft o.a. communicatie-instrumenten om voldoende bekendheid te geven aan de duurzaamheidcriteria en om voor een breed draagvlak te zorgen

Vervolgactiviteiten
Het is noodzakelijk om in de tweede helft van 2006 de voorgestelde duurzaamheidindicatoren nader uit te werken om inpassing in overheidsbeleid mogelijk te maken. Dit betreft de uitwerking van protocollen voor de rapportageverplichtingen, de rekenmethodiek voor de broeikasgasbalans, de selectie en opzet van pilotprojecten, de aanpak van dialoog met stakeholders en het opzetten van een structuur om certificering en verdere uitwerking van prestatie-indicatoren mogelijk te maken. Het is gewenst om bij de nadere uitwerking van protocollen en indicatoren ook stakeholders uit de biomassa producerende landen te betrekken.

Om wetenschappelijk onderbouwde prestatie-indicatoren voor 2011 te ontwikkelen is nader onderzoek noodzakelijk. Hierbij kan gebruik worden gemaakt van de informatie die beschikbaar komt door de verplichte rapportages in 2007. Om tijdig prestatie-indicatoren te hebben geformuleerd, is het noodzakelijk om op korte termijn noodzakelijk onderzoek te starten. Dit kan worden opgezet in samenwerking met het Platform Groene Grondstoffen, dat in de komende maanden een schets uitwerkt van een dergelijk onderzoeksprogramma.

De projectgroep is bereid om in haar huidige samenstelling zorg te dragen voor de uitvoering van bovengenoemde vervolgactiviteiten. Gezien de complexiteit van het onderwerp en de opgebouwde kennis heeft het meerwaarde om de huidige projectgroep die taak te laten uitvoeren. Bovendien is een structuur opgezet waarbij de leden van de projectgroep regelmatig met de belangrijkste stakeholders uit hun achterban communiceren. In de discussies is dit heel waardevol gebleken.

The project group developed a number of biomass sustainability criteria and indicators/procedures for the short-term (2007) and the medium term (2011), see Table 1.

While it is clear that for most of such criteria, indicators and procedures still need to be developed, these approaches show promise to cover all sustainability aspects of biomass production. What is more important to emphasize is that such criteria cannot be developed overnight. The procedure is to set minimum levels of sustainability criteria now, but pilot cases are required to build up experience of how sustainability criteria can be met under diverse conditions.

Table 1: Summary of sustainability criteria (Cramer principles), indicators/procedures and suggested levels for 2007 and 2011 (DPB, 2006):

Criterion and level	Indicator/procedure 2007	2011
1. GHG balance, net emission reduction by >=30% in 2007 and >= 50% in 2011	Testing with the aid of calculation methods Use of standard values for different steps in standard chains	As 2007
2. Competition with food, local energy supply, medicines and building materials Insight in the availability of biomass for above in 2007, Supply is not allowed to decrease in 2011	Footnote a[2]	Footnote b[3]
3. Biodiversity, No deterioration of protected areas or valuable ecosystems, also insight into active protection of local eco-systems in 2011	No plantations near gazetted protected areas or High Conservation Value areas maximum 5% conversion of forest to plantations within 5 years Footnote a	As 2007 Additional obligatory management plan for active protection of local ecosystems Footnote b
4. Economic prosperity, insight into possible negative effects on the regional and national economy in 2007, insight into active contribution to the increase of prosperity in 2011	Footnote a, based on Economic Performance indicators as expressed in the Global Reporting Initiative	Footnote b
5. Well-being, including		
5.a Working conditions of workers No tightening in 2011	Compliance with Social Accountability 8000 and other treaties	As 2007
5.b Human rights No tightening in 2011	Compliance with universal declaration of Human Rights	As 2007
5.c Property rights and rights of use No tightening in 2011	Three criteria from existing systems (RSPO 2.3, FSC 2, FSC 3)	As 2007
5.d *Insight in social conditions of local population* In 2011, insight into active contribution to improvement of social circumstances local population	Footnote a	Footnote b
5.e *Integrity* No tightening in 2011	Compliance with Business principles of countering bribery	As 2007
6. Environment, No negative effects on the environment including:		
6.a Waste management No tightening in 2011	Compliance with local & national legislation and regulation, GAP principles	As 2007
6.b use of agro-chemicals (incl. Fertilizers)	Compliance with local & national legislation and regulation	Comply with strictest EU, local, national rules and legislation
6.c Insight into the prevention of erosion and soil exhaustion, and conservation of the fertility level	Footnote a. Reporting includes following aspects: * Erosion management plan; * Prevention of extensive cultivation on steep slopes, marginal or vulnerable soil; * Monitoring of the condition of the soil and management plan * Nutrient balance	Footnote b
6.d Insight into the conservation of quality and quantity of surface and groundwater	Footnote a, special attention for water use and treatment	Footnote b
6.e Emissions to air	Comply with local and national legislation and regulations	Comply with EU regulations
For criteria 2-6 a dialog with national and local stakeholders is required.		

[2] For this criterion a reporting obligation applies. A protocol for reporting will be developed.
[3] New performance indicators will be developed for this criterion between 2007-2011.

3.2 Duurzaamheid in internationaal perspectief

Nederland is niet het enige land (of actor) dat probeert duurzaamheidcriteria voor biomassaproductie en handel te ontwikkelen. Appendix III ([van Dam et al., 2006]) geeft een internationaal overzicht van activiteiten op dit vlak. Voor een belangrijk deel betreft het actoren of initiatieven waar Nederland samenwerking mee zoekt (zie ook de volgende sectie: Internationale dialoog en afstemming)

In dit, vroege, stadium, waarin de internationale biomassamarkten zich nog aan het vormen zijn is het dus van groot belang samen te werken met andere landen en de dialoog aan te gaan met leidende partijen. Deze dialoog is belangrijk voor het verkrijgen van draagvlak voor duurzame biomassa productie en handel, maar ook voor het verkrijgen van inzicht hoe dergelijke randvoorwaarden het meest effectief kunnen worden verankerd in de markt. Een essentiële vraag is daarbij hoe een optimaal evenwicht kan worden gevonden tussen het garanderen van duurzaamheid in biomassaproductie versus haalbaarheid en hanteerbaarheid in de markt. Daarbij kunnen lessen worden geleerd van bestaande certificeringschema's (zie ook: [Lewandowski en Faaij, 2006] en [Fritsche et al., 2006]). Niet zelden zijn ‘strenge’ schema’s beperkt tot een kleiner deel van de markt van een bepaald product (en wordt dus de mainstream markt niet bereikt; een voorbeeld daarvan zijn fairtrade producten) versus schema’s gericht op ‘minimum’ eisen die weliswaar minder strikt zijn, maar wel worden gehanteerd voor de bulk van de markt.

Een ander aspect is de ontwikkeling van dergelijke, duurzame, markten in de tijd. De ontwikkeling en implementatie van relatief succesvolle schema’s als FSC (voor bosbouw) heeft veel tijd gevraagd en het schema is nog steeds in ontwikkeling. Een dergelijke lange termijn kijk op certificering van biomassa en bio-energie is op voorhand verstandig.
Het is op dit moment echter nog onduidelijk wat het of de meest geschikte trajecten zijn voor het implementeren van internationaal breed gedragen **en** effectieve certificering. Voor Nederland zal vooral de opstelling van Europese Commissie en het draagvlak om een Europese standaard voor geïmporteerde biomassa te introduceren van groot belang zijn. De commissie heeft in haar Biomassa Actie Plan voor een dergelijke aanpak gepleit.

Enerzijds zijn er veel inhoudelijke issues op te lossen. Zekerstellen van duurzaamheid van biomassaproductie in brede zin voor de in de tabel genoemde aandachtgebieden is bijzonder complex. Voor een belangrijk deel van de criteria (bv. tav landgebruik en biodiversiteit, sociaal economische ontwikkeling en diverse, cruciale, milieuthema’s (water, bodemkwaliteit) zijn geen pasklare standaarden beschikbaar. Op deze gebieden ontbreekt deels zelfs een wetenschappelijke basis om (kwantitatief) criteria vast te stellen en te verifiëren. Deze complexiteit wordt sterk vergroot door de grote diversiteit biomassaproductiesystemen en omstandigheden in potentiële productielanden.
Anderzijds liggen er vragen alsmede verschillende opties tav governance van biomassa markten. Omdat de internationale handel in biomassa nog volop in ontwikkeling is, is nog onduidelijk welke spelers de markten gaan controleren. Op dit moment is er nog veel ruimte voor beleidskeuzen, initiatief vanuit de markt (zowel gebruikers als producenten) en internationale overeenkomsten.

Een belangrijke strategie voor de komende jaren is dan ook:

- Verdere uitwerking en toepassing van het criteriaraamwerk als betoogd door de werkgroep Duurzame Biomassa Productie; opbouwen van de noodzakelijke wetenschappelijke kennisbasis, voor ontwerpen en monitoren van duurzame biomassaproductiesystemen onder verschillende omstandigheden. Initiëren van een programma voor flankerend wetenschappelijk onderzoek tbv ontwikkeling indicatoren, monitoringmethodieken en ontwerpmethodieken voor duurzame biomassaproductie.
- Daarmee direct samenhangend het opzetten van een coherente set pilots en demo's voor opzetten en bedrijven van duurzame biomassa productie en aanvoerketens. Opbouwen van ervaringen onder verschillende omstandigheden en daarmee, structureel, demonstreren en uitwerken van het duurzaamheidraamwerk. Een coherent programma van ca. 6 jaar lijkt daarvoor reëel. Dit kan vorm krijgen dmv bilaterale samenwerking. Dergelijke pilots zouden de inzichten en bewijsvoering moeten leveren of biomassaproductie op grote schaal duurzaam kan worden gerealiseerd in verschillende contexten.

Coherentie is belangrijk. Pilot en demonstratieactiviteiten dienen te worden ontwikkeld binnen *alsmede* bij te dragen aan het duurzaamheidraamwerk. Het is onwenselijk dat een groot aantal niet samenhangende initiatieven wordt ontplooid die mogelijk verschillende boodschappen af gaan geven. Dit pleit voor een programmatische aanpak in een internationale setting.
Daarnaast is betrokkenheid van relevante stakeholders, met name in producerende landen van groot belang. Er lijkt consensus te bestaan dat opstellen en toepassing van criteria (en de weging daarvan) in nauwe samenspraak met betrokken partijen, draagvlak en effectiviteit van certificering sterk vergroot. Dit maakt het mogelijk met een meer universeel, algemeen raamwerk te werken en dat regionaal toe te passen (uiteraard wel met vastgelegde kaders en methoden voor vaststellen en monitoren van impacts). Opzetten van pilot en demonstratieprojecten betekent dus ook een participatieve benadering.

3.3 Internationale afstemming en dialoog

De ontwikkeling van biomassamarkten, productiecapaciteit, certificeringschema's, logistieke capaciteit, etc. is geen zaak van Nederland alleen. Als beschreven, zijn er soortgelijke ontwikkelingen gaande in andere landen. In Europa zijn Duitsland, het Verenigd Koninkrijk, Zweden en Italië al belangrijke importeurs van bio-energie op de internationale markten. Japan en andere landen in Oost Azië zullen naar verwachting op korte termijn een grote invloed hebben op de vraag naar biomassa en biofuels. Tegelijkertijd zullen door een ontwikkelende vraag meer en meer landen (en sectoren) biomassa en biofuels gaan leveren. Voorbeelden zijn Rusland, Oekraïne, de Mercosur regio in Zuid Amerika, Zuidelijk Afrika en de nieuwe EU lidstaten in Centraal en Oost Europa. Draagvlak voor (bv.) certificering en mate waarin dat wordt toegepast is dus een internationale kwestie. Het is de vraag in hoeverre een specifiek Nederlands standpunt in zo'n internationale setting kan worden gehandhaafd.
Voor Nederland is het op korte termijn van belang van met een aantal cruciale actoren nauw samen te werken en ervaringen uit te wisselen:

De Europese Commissie: alhoewel het onzeker is hoe de commissie haar beleid tav bio-energie en biofuels op langere termijn zal voortzetten is zij een belangrijke motor achter de groeiende rol van biomassa als energiebron in Europa. De EC heeft in haar recente Biomassa Actie Plan gepleit voor ontwikkeling van systemen om de duurzaamheid van biomassa te garanderen en tevens toe te staan dat een deel van Europese doelen wordt gehaald door import van biomassa. De gedachtevorming over mogelijkheden van certificering, wetgeving, marktontwikkeling, etc. op Europees niveau loopt daarmee min of meer parallel met het Nederlandse proces. Indien op Europees niveau, bv. met leidende lidstaten op dit terrein als Duitsland, Zweden, Nederland en mogelijk ook het Verenigd Koninkrijk en Frankrijk, wordt samengewerkt, met als doel een Europees standpunt in deze, dan kan dat op kortere termijn op de vorming van internationale biomassamarkten veel invloed hebben. De Europese Unie heeft tot zover ook een zeer sterke positie weten in te nemen in de WTO onderhandelingen.

Internationale instituties: UNCTAD, FAO, UNEP, Wereldbank, GEF: Ook op het niveau van internationale instituties is het belang van bio-energie en de ontwikkeling van internationale markten inmiddels breed geagendeerd (zie ook Appendix IV):

UN Biofuels Initiative (UNBI) is opgericht om duurzame productie en gebruik van biofuels in ontwikkelingslanden te stimuleren, onder de voorwaarde dat dit aantrekkelijk is voor internationale en nationale investeerders. UNBI zal potentiëlen verkenen en samenwerken met nationale beleidsmakers, marktpartijen, NGO's, etc. om landspecifiek strategieën (zogenaamde nationale biofuels actieplannen) op te stellen voor productie en gebruik van biobrandstoffen. Het initiatief is gecoördineerd door UNCTAD (VN commissie voor handel) en werkt samen met FAO, UNDP, UNEP en UNICDO

FAO: FAO werkt als organisatie wereldwijd aan voedselzekerheid, (duurzame) landbouw, etc., maar ontplooit ook belangrijke activiteiten op het terrein van bio-energie in ontwikkelingslanden. Belangrijk is dat de FAO vanuit de CSD (Committee for Sustainable Development het mandaat heeft gekregen een internationaal leidende positie in te nemen. De belangrijkste exponent hiervan is de creatie van het International Bio-energy Platform (IBEP). Hierbij wordt ook nadrukkelijk gestreefd naar internationale samenwerking.
IBEP heeft onder meer tot doel e informatiebasis over bio-energie voor beleidsmakers en ondernemers (in ontwikkelingslanden) te verbeteren, tools aan te leveren, capacity building en

daadwerkelijke realisatie van duurzame bio-energieprojecten. Dit omvat ook activiteiten die zijn gericht op de internationale markt.

UNEP werkt eveneens aan certificering van biofuels en initiatieven om duurzame biomassaproductie te realiseren in ontwikkelingslanden, o.m. in Afrika.

De Wereldbank heeft biofuels en de link tussen internationale markten en ontwikkeling geagendeerd voor haar programma's. In combinatie met het GEF (Global Environment Facility) zijn investeringen in grotere bio-energie en export georiënteerde projecten en programma's komende jaren te verwachten.

In alle gevallen is het aanbevelenswaardig als Nederlandse activiteiten worden afgestemd met en bij voorkeur worden opgezet in samenspraak met dergelijke initiatieven. Dit geldt in het bijzonder voor het IBEP van FAO en het UNCTAD biofuels initative. Demonstratieprojecten voor duurzame biomassa (en mogelijk certificering en export) met betrokkenheid van dergelijke instituties kan de geloofwaardigheid en 'outreach' van dergelijke projecten sterk vergroten.

De WTO; Ontwikkeling van handel in biomassa en biobrandstoffen dient, uiteraard, conform WTO handelsovereenkomsten plaats te vinden. Afstemming met de WTO van iedere activiteit tav certificering, verminderen van barrières (of het opwerpen daarvan) is daarom van het grootste belang. Alhoewel er diverse stellingnamen zijn te beluisteren over wat de WTO wel en niet zou toelaten tav duurzaamheidseisen voor biomassa voor energie is er vooral nog onduidelijkheid. In bijlage V is een sectie opgenomen uit een paper van de UNCTAD over bio-energy trade *"the WTO Implications'*: [Zarilli, 2006].
Er is ruimte voor het implementeren van duurzaamheidcriteria, maar hoe dat binnen de WTO kaders optimaal kan zal ook een kwestie worden van onderhandelen. Ervaringen met certificering, gedragen door een (kleine) groep actieve landen (en NGO's) zouden dit onderwerp op afzienbare termijn kunnen agenderen binnen de WTO.

4. Biomassa resources en productie en exportmogelijkheden

4.1 Potentiële biomassa resources

Zoals al in de inleiding is aangegeven zijn er verschillende biomassastromen die een significant aandeel hebben of kunnen hebben op de beschikbaarheid van biomassa op termijn. Appendix I geeft een meer gedetailleerde assessment van inzichten (en randvoorwaarden) in toekomstige mondiale productiepotentiëlen.
In dit document wordt sterk (alhoewel niet exclusief) de nadruk gelegd op meerjarige gewassen (bomen en grassen) ofwel lignocellulose biomassa (inclusief reststromen). Hiervoor zijn een aantal redenen:

- de ecologische impacts van meerjarige gewassen zijn (veel) gunstiger dan voor traditionele landbouwgewassen. Dit geldt voor de broeikasgasbalans, emissies van meststoffen en landbouwchemicaliën, impacts op bodems en mogelijke diversiteit in aanplant.
- De productie (per eenheid energie) is (aanmerkelijk) goedkoper.
- Meerjarige gewassen kunnen ook op lagere kwaliteit bodems (marginale en gedegradeerd gronden) groeien, waardoor concurrentie met goede kwaliteit landbouwgronden kan verminderen.
- Lignocellulose is de meest geschikte grondstof voor synthetische brandstoffen (zoals Fischer-Tropsch diesel) en elektriciteitsproductie, ook in combinatie met kolen.

Grofweg kan onderscheid gemaakt worden tussen drie hoofdcategorieën:

1. Reststromen en organisch afval.
Biomassa reststromen van de landbouw, bosbouw en organisch afval (naar verwachting goed voor (ruim) 100 EJ en de minst onzekere van de hier genoemde categorieën (zie ook de conservatieve schatting van de World Energy Council [Hoogwijk et al., 2003). Alhoewel er regionaal grote verschillen mogelijk zijn, zijn de kosten van (verzamelde en getransporteerde) reststromen en afval betrekkelijk laag. Rond de 2 Euro/GJ is vaak haalbaar. Voor afvalstromen kan dit lager zijn, voor afgelegen bosgebieden hoger. Veel impacts die onder duurzaamheidcriteria zijn genoemd zijn niet

van toepassing op residuen, maar de mate van verwijdering en benutting (o.m. organisch stofgehalte van de bodem en nutriëntenbalans) zijn belangrijke aandachtspunten.

2. Biomassa productie op marginale en gedegradeerde gronden.
'Marginaal & gedegradeerd' is een containerbegrip waaronder vele soorten land vallen; gerodeerde grond die niet langer geschikt is voor landbouw (of veeteelt), gronden die niet economisch zijn voor landbouwproductie, verzilte bodems, etc. In totaal wordt 1.700 miljoen hectare (ca. 13% van het wereld landoppervlak) tot deze categorie gerekend. Delen van dit areaal worden wel degelijk benut (bv. voor extensieve veeteelt), hebben biodiversiteitswaarden of zijn niet geschikt voor biomassaproductie (bv. door een gebrek aan water). Desalniettemin zijn er grove schattingen dat wereldwijd tot ca. 600 miljoen hectare in aanmerking kan komen voor bv. herbebossing en regeneratie (dit is exclusief opties als aanplant op verzilte bodems, die dit getal verder kunnen verhogen). Productie van biomassa (bv. bosaanplant of jatropha voor productie van oliezaden) is laag; tussen 2 tot maximaal 10 ton droge stof/hectare*jaar (met 3-5 ton/ha*jr als redelijke range). Vaak zijn relatief hoge (begin) investeringen nodig om aanplant mogelijk te maken. Gecombineerd met lagere productiviteiten maakt dat biomassaproductie, ondanks vaak verwaarloosbare kosten voor grondgebruik, op dergelijke gronden relatief duur. In veel gevallen liggen de productiekosten ruim boven de 2 Euro/GJ; een kostprijs die in het algemeen geldt als concurrerend niveau met fossiele brandstoffen. Circa 100 EJ zou met deze gronden kunnen worden geproduceerd [Hoogwijk, 2003]. Ondanks naar verwachting hogere kosten, is deze categorie vanuit duurzaamheidoogpunt juist interessant. Competitie met voedselproductie is (veel) minder sterk dan op bestaande landbouwgrond. Verder is het is in veel situaties wenselijk dergelijke gronden te herbeplanten met als doelen erosiebestrijding, geleidelijke regeneratie van bodems (waaronder terugdringen van verzilting, vervuiling en opbouw organische stof) verbeterde waterretentie, etc. In gunstige situaties zouden bodems op termijn weer geschikt kunnen worden voor conventionele landbouw. Allocatie van kosten over biomassaproductie en dergelijke functies kan toch leiden tot economisch interessante schema's. Dit vereist wel beleid dat dergelijke 'co-benefits' ook internaliseert, bijvoorbeeld middels subsidies.

3. Biomassa productie op goede kwaliteit landbouwgrond en grasland.
Op goede landbouwgronden of graslanden kunnen hoge(re) productiviteiten worden gehaald van 10 tot meer dan 30 ton droge stof/hectare*jaar. In veel regio's in de wereld is het mogelijk (bv. middels grasteelt of plantages) productiekosten te halen tussen 1-2 Euro/GJ. Deze categorie biomassa heeft, technisch, het grootste productiepotentieel; Smeets et al., (2006) laten zien dat een technisch potentieel tot meer dan 600 EJ kan worden geproduceerd op de huidige gronden die in gebruik zijn voor voedselproductie (akkerland en grasland) naast het voldoen aan de toekomstige wereldvoedselvraag, behoud van bos en natuurgebieden. Dit kan onder de voorwaarde dat er (zeer) efficiënte landbouw- en veeteeltmethoden wereldwijd worden toegepast. Dat zal logischerwijze zelfs op langer termijn niet overal ter wereld het geval zijn. Een bijdrage van ca. 200 EJ (economisch potentieel) aan het begin van de 2^{e} helft van deze eeuw lijkt echter haalbaar (zie ook appendix I voor meer achtergrondinformatie). Energieteelten op landbouwgrond zijn dus de belangrijkste resource categorie voor de middellange en langere termijn. Dit is echter ook waar de meeste vragen vanuit duurzaamheidoogpunt over zijn te stellen. Verdringing van en competitie met landbouw en indirect verhoogde druk op bos- en natuurgebieden zijn daarbij de belangrijkste problemen. Een cruciale vraag is dus hoe een geleidelijke toename van biomassaproductie op gebalanceerde wijze kan worden gecombineerd met verbeteringen in landbouwproductiviteit.

Verder kan gestreefd worden naar multifunctioneel landgebruik in het algemeen. Het kan dan gaan om biomassaproductie ook andere functies te geven zoals: bufferzones rondom natuurgebieden, fytoremediatiefuncties voor bv. verwijdering van zware metalen uit bodems en agroforestry systemen, waarbij bomen bv. schaduw en bescherming tegen erosie leveren voor conventionele landbouwgewassen.

4.2 Selectie van regio's en landen voor ontwikkeling van biomassaproductie en exportcapaciteit

Niet iedere regio heeft goede uitgangspunten voor het verhogen van biomassaproductie en mogelijk export. Gebieden met een lage bevolkingsdichtheid, relatief extensief grondgebruik en een beperkte groeisnelheid in de vraag naar voedselproducten zijn in eerste instantie het meest geschikt.
Uitgangspunten voor de ontwikkeling van (potentiële) biomassaproductie en exportcapaciteit zijn:

- Afdoende groot biomassaproductiepotentieel binnen duurzaamheidsrandvoorwaarden. Dit moet ook gelden op langere termijn; in veel regio's zal de vraag naar voedsel en energie stijgen en de druk op beschikbaar land toenemen. Biomassaproductie (voor export) kan op termijn in dergelijke regio's dus moeilijker worden en/of de vraag naar energie kan export op termijn onaantrekkelijk maken. Een omgekeerde ontwikkeling is echter ook mogelijk (bv. Oost Europa).
- Het investeringsklimaat en stabiliteit dient afdoende te zijn. Ook kan een rol spelen of Nederland al een relevante samenwerkingsrelatie heeft door actieve bedrijven of ontwikkelingssamenwerking.
- Representatief voor een groter gebied (of zelf groep van landen) zodat er herhalingspotentieel is.

Andere aspecten die van belang zijn:
- Marktontwikkelingen voedsel, bosbouw, Biomaterialen
- Landbouwbeleid en aanpalende terreinen (biodiversiteit, water)
- Handelsakkoorden barrières en tarieven.

Het aantal trajecten (pilots, demonstratie en verdere uitbreiding naar commerciële operaties) dient bij voorkeur een divers portfolio te omvatten van de drie hoofdcategorieën genoemd in sectie 5.1. Dit is wenselijk vanuit oogpunt van risicospreiding, het verkrijgen van zo breed mogelijk inzicht (tav zekerstellen van duurzaamheid, maar ook qua organisatie van logistieke ketens) en spreiding van activiteiten en aanvoer in de tijd (zie sectie 6). Deze diversiteit betreft onder meer geografie (sociaal economisch ontwikkelingspeil, type landbouw, klimaat, bodems, natuurlijke vegetatie, etc.), teelt (plantage, agro-forestry, grassen) en logistiek (geconcentreerd versus dispers).

Een gedetailleerde analyse en vergelijking van regio's in het licht van dergelijke uitgangspunten is tot zover niet beschikbaar. Maar op basis van bestaande modellen, databases en analyses (wederom Hoogwijk et al en Smeets et al., 2006) zijn er wel globale indicaties mogelijk. Tabel 2 geeft een aantal opties. Andere gebieden zijn logischerwijze ook mogelijk (delen van Centraal Afrika, Colombia, Cuba en delen van Centraal Amerika, Australië)

Tabel 2: Potentieel belangrijke regio's met karakteristieken voor biomassaproductie voor export.

Gebied	Belangrijkste karakteristieken	Biomassaproductie opties
MERCOSUR regio (Brazilië, Uruguay, Paraguay, Argentinië	Groot productiepotentieel met lage kosten, relatief goede infrastructuur.	- Landbouwresiduen (bagasse) - Agro-forestry schema's - Suikerriet (uitbreiding) - Management van graslanden, - Eucalyptus
Zuid Oostelijk Afrika (Mozambique, Malawi, Zambia, Tanzania)	Groot productiepotentieel, deels ook op marginale gronden. Representatief voor grote delen van Afrika.	- Suikerriet - Laag productieve bosaanplant; semi-aride condities. - Landbouw residuen. - Jatropha.
Centraal & Oost Europa (Polen, Roemenië, Oekraïne)	Significant potentieel, dichtbij. (deels EU), op termijn relatief lage druk op beschikbare gronden door demografische trends.	Wilg, populier, energiegrassen als miscanthus.
Rusland en Canada	Grote bosarealen die deels relatief extensief worden benut; korte termijn beschikbaarheid.	Bosbouwresiduen
Zuid Azië	Grote arealen gedegradeerde grond; representatief voor andere delen in de wereld. Grote interne vraag naar energie, dus mogelijk minder geschikt voor export.	Gebruik van gedegradeerde, verzilte gronden (Biosaline systemen); aanplant boomsoorten. Jatropha.

4.3 Logistiek, infrastructuur, handel

Voor export is organisatie van logistiek, infrastructuur, handel en certificering van groot belang. Logistieke operaties (vanaf de oogst van een gewas, voorbehandeling (zoals pelletiseren) tot en met aanlevering aan het finale conversieproces) kunnen typisch een derde van de totale productiekosten van elektriciteit uit biomassa of biobrandstof beslaan (zie o.a. [Hamelinck et al.,

2005]). Al dan niet beschikbaar zijn van infrastructuur en logistieke capaciteit kan een belangrijke barrière vormen voor het ontwikkelen van biomassapotentiëlen en handel (zie ook appendix II). Voor het opzetten van pilot en demonstratieprojecten is logistiek een belangrijke component. En ook voor het realiseren van de 'doelen' van de energietransitie tav biomassa is opbouw van logistieke capaciteit een essentieel aspect gezien de grote volumes. Nadere analyse is nodig hoe die infrastructuur zich kan en dient te ontwikkelen in de tijd om de geprojecteerde bijdragen aan energie- en materiaalvoorziening mogelijk te maken. Import van vloeibare transportbrandstoffen bijvoorbeeld vergt wezenlijk andere capaciteit dan import van vaste energiedragers als pellets en waarbij de finale conversie (bv. vergassing) plaatsvindt in Nederlandse zeehavens.

Naast fysieke infrastructuur (lokaal transport, voorbehandelingcapaciteit, op- en overslag, internationaal transport, havencapaciteit en de finale conversie, zijn ook ervaring met handel, transport en logistiek van belang. Het optimaliseren van sourcing, logistieke ketens, tracking & tracing, auditing en certificeringsprocessen zijn een wezenlijk onderdeel van ontwikkeling van bommassaproductie en importcapaciteit.

5. Tijdpad, milestones en actiepunten

5.1 Hoofdlijnen

Deze roadmap geeft een visie hoe de transitiedoelstelling voor biomassa, ihb wat betreft grootschalige import van duurzame biomassa, die naar schatting 600-800PJ zou moeten bedragen in 2040 kan worden gehaald. Na 2020-2025 zou biomassa-import onder marktcondities moeten kunnen plaatsvinden met een sterk rol voor diverse Nederlandse sectoren. Nogmaals wordt benadrukt dat in dit document geschetste leer- en implementatietraject tevens de bewijsvoering moet leveren of en hoe biomassa op duurzame wijze in landen elders op de wereld kan worden geproduceerd. Die duurzaamheid is op voorhand geen gegeven, maar vergt een traject voor het opbouwen van kennis en (commerciële) ervaring.
De periode voor 2020 is nodig voor het opbouwen van de vereiste kennis ervaring; een periode waarin naast onderzoek, pilot- en demonstratieactiviteiten ook wezenlijke ondersteuning van de markt nodig is om de naar verwachting hogere kosten dan conventionele fossiele energiedragers te compenseren. Een belangrijk uitgangspunt is dat geleidelijke kostenreductie door 'learning' en schaalvergroting in de tijd in de tijd moet worden bereikt. Cruciaal is dat de rijksoverheid voor de komende 15 jaar een stabiel pad schetst en zekerheid verstrekt over het te verwachten niveau van ondersteuning en hoe dat in de tijd wordt geleidelijk (naar beneden) wordt bijgesteld.

De sectie hieronder geeft een schets van een samenhangend programma voor realisatie van duurzame biomassa productie en import ketens. In dit programma nemen de belangrijkste Nederlandse stakeholders (marktpartijen, kennisinstellingen, overheden, NGO's) deel. De structuur is flexibel, zodat aansluiting kan worden verkregen met vergelijkbare, internationale, activiteiten om maximale synergie te bereiken.

5.2 Nationaal programma duurzame biomassa import

<u>Doelen:</u>
Ontwerpen en demonstreren van duurzame biomassa productie en aanvoerketens. Biomassastromen zijn zowel afkomstig van residuen en actieve teelt in verschillende (representatieve) situaties en regio's in de wereld. Dit omvat tevens de volledige operationalisering van duurzaamheidcriteria in brede zin: ecologische aspecten (watergebruik, bodemkwaliteit, biodiversiteit, landgebruik en concurrentie) en sociaal-economische aspecten (rurale ontwikkeling, (voedsel en andere) markteffecten, macro-economische effecten).
Het programma zal ook leiden tot ontwikkeling en demonstratie van geoptimaliseerde productie, logistieke (transport, voorbehandeling, opslag) en eindgebruikketens en de ontwikkeling van logistieke, organisatorische en handelscapaciteiten. Het programma in totaal dient een volwaardige kennisbasis op te leveren voor grootschalige ontwikkeling van duurzame en commerciële biomassaproductie en importcapaciteit conform de visie van het Platform Groene Grondstoffen. De nadruk ligt op productie en levering van lignocellulose biomassa en uiteindelijke productie van 2^{e} generatie biobrandstoffen (synfuels en ethanol geproduceerd uit houtige biomassa) en productie van elektriciteit in geavanceerde nieuwe generatie elektriciteitscentrales.

Beoogde resultaten:

Ontwikkeling van duurzame biomassaproductie en aanvoerschema's voor verschillende biomassacategorieën en productieregio's:

Omvat het gebruik van biomassa residuen (bijvoorbeeld uit land- en bosbouw), biomassaproductie op goede kwaliteit gronden, geïntegreerd in bestaande landbouw (en veeteelt) systemen en biomassa productie op marginale gronden (bijvoorbeeld door erosie beschadigde bodems, verzilte gebieden, etc.) Verschillende business cases vormen het hart van het programma. Deze omvatten het ontwerp, aanleg, monitoring en evaluatie en duurzaamheidtoets van de biomassa productie en transportketens. Bewust wordt gestreefd naar een divers portfolio regio's en productiesystemen die recht doet aan de diversiteit aan potentiële biomassabronnen en productieregio's op middellang en langere termijn. Veelbelovende en relevantie regio's zijn al kort genoemd in sectie 5.2 van dit document.

Indicatieve grootte van de pilots beoogd rond ca. 2011 zijn ongeveer 1 PJ biomassaproductie per jaar (bv. 2.000-10.000 ha productiegebied afhankelijk van de productiviteit en percentage land gebruikt voor biomassaproductie). Na 2011 zou de grootte van de pilots moeten uitgroeien naar circa 10 PJ/jr (20.000 – 100.000 ha) tot ca. 2015. Met een dergelijke grootte kan de basis worde gelegd voor commerciële productieschema's voor 2020, gericht op biomassaproductiekosten op onder de 2 Euro/GJ.

Andere deliverables omvatten:

- Een integrale methodiek voor ontwerpen van duurzame biomassaproductiesystemen en ketens voor export binnen geformuleerde duurzaamheidcriteria.
- Bewezen methoden, tools en kwantitatieve indicatoren voor coherente analyse van impacts van biomassaproductie als aangegeven in duurzaamheidkaders.
- Ex-post en ex-ante analyse van de impacts van grootschalige biomassa productie in concrete regio's (ihb. Ontwikkelingslanden). De kern van dit werk is gebaseerd op veldwerk, regionale data en wordt uitgevoerd in nauwe samenwerking en dialoog met relevante regionale stakeholders.

2. Transport, logistiek en conversie: geoptimaliseerde biomassa productie, lokale en internationale logistiek en finale conversie ketens, gericht op maximalisatie van broeikasgas emissiereducties (circa 90% reductie vergeleken met fossiele referentieketens) en kostenminimalisatie voor levering van 2e generatie biobrandstoffen en elektriciteitsproductie. Het ontwerp en demonstratie van complete ketens inclusief efficiënte voorbehandelingtechnologieën (bv. Torrefactie, pyrolyse en pelletiseren) is expliciet onderdeel van het programma. Een finaal doel is levering van voorbehandelde biomassa (bv. Pellets of pyrolyse-olie) tegen kostprijzen rond 3 Euro/GJ aangeleverd in Nederlands zeehavens. Een dergelijk kostprijs is afdoende om te kunnen concurreren met de belangrijkste fossiele energieketens.

3. Strategie, marktontwikkeling en handel, beleidskaders en dialoog met betrokken stakeholders op internationaal niveau. Dit omvat:

- Opbouwen van stakeholdernetwerken, inclusief regionale partnerships voor het opzetten van pilot- en demonstratieprojecten.
- Het ontwerpen, demonstreren en opbouwen van breed draagvlak voor duurzame productie en levering van biomassa, inclusief organisatie van tracking- en tracing en verificatie van duurzaamheidcriteria.
- Coherent en gedetailleerd ontwerp en ontwikkelingstrajecten voor grootschalige biomassaproductie en exportcapaciteit op middellange termijn voor geselecteerde regio's.
- Strategie en gekwantificeerde roadmaps voor verdere internationale marktontwikkeling, inclusief goed gefundeerde kostenschattingen en benodigde investeringen en risico's. Gerichte aanpak en dialoog voor opbouw internationaal draagvlak voor toepassing van duurzaamheidcriteria en monitorings- en verificatiesystemen.

Organisatie

Het programma omvat verschillende, gelinkte, fasen met duidelijk beslismomenten mbt tot het implementeren van pilotprojecten en verdere uitbouw naar demonstratieniveau. Het programma heeft het karakter van een platform en kan nadrukkelijk worden gelinkt aan andere projecten en programma's (bijvoorbeeld in het buitenland). Een sleutelstrategie is om het programma in de tijd te combineren met investeringen door andere partijen (bv. nationale overheden, internationale partijen en bedrijven) Voorbeelden zijn: bestaande marktactiviteiten voor biomassa gebruik, handel en certificering, nationaal gefinancierde projecten (bv. binnen de UKR), EC gefinancierde activiteiten

en internationale samenwerking met partnerlanden (BZ/OS), internationale samenwerking onder de vlag van FAO's International Bio-energy Programme (IBEP), de UNEP of GEF. Samenwerking met andere nationale initiatieven (bv. vanuit Duitsland, Verenigd Koninkrijk, Zweden of Frankrijk) is een andere belangrijke optie.

Het programma zou moeten worden bestuurd door een raad van bestuur bestaande uit directeuren en coördinatoren van de (belangrijkste) deelnemende marktpartijen, onderzoekspartners, NGO's, beleidsmakers van betrokken ministeries. Essentiële stakeholders zijn de energie-, landbouw- en bosbouwsectoren, overheid, financieel, transport, handel en logistiek en onderzoek en ontwikkeling. In de beoogde productieregio's dienen duurzame samenwerking en partnerships te worden gerealiseerd. Dergelijke partnerships omvatten iig boerenorganisaties/landeigenaren, regionale en nationale overheden, relevante actoren uit de energie- en bosbouwsector, relevante NGO's, etc.
Verder worden geformaliseerde links nagestreefd met FAO's IBEP, het Global Bioenergy Partnership (GBEP) van de G8, IEA kaders, het UN Biofuels initiatief en relevante ontwikkelingen op het niveau van de EU.

Dit programma richt zich met name op de Biomassa Upstream kant van de zaak, inclusief strategieontwikkeling hoe markten en infrastructuur in de tijd verder kunnen worden ontwikkeld. Sterke links met andere deelprogramma's van de energietransitie (bijvoorbeeld ten aanzien van het ontwikkelen van biomassaconversietechnologie en capaciteit voor brandstoffen en Biomaterialen) dienen uiteraard sterk te zijn en onderdeel van een coherente totaalstrategie zoals gepresenteerd door het Platform Groene Grondstoffen.

Tabel 3 geeft een eenvoudige fasering met belangrijke stappen voor het beoogde onderzoeks- en demonstratieprogramma duurzame biomassaproductie en import.

Periode	Volume	Kostentargets voor biomassa geleverd in Nederlandse zeehavens.	Belangrijkste activiteiten
2007-2012	Diverse pilots van enkele PJ per jaar	5 Euro/GJ	Ontwikkeling van volledig gecertificeerde importketens op basis van reststromen. Haalbaarheidsanalyses van diverse regio's voor actieve productie van biomassa. Opbouwen van partnerships en opstarten internationale dialoog. Gedetailleerde plannen van aanpak voor actieve biomassa productie in geselecteerde regio's (landbouwgrond en gedegradeerde gronden, variëteit aan productiesystemen. Creatie van stakeholdernetwerken in en rond beoogde regio's en landen, uitgebreide analyse van verwacht impacts en ontwerp duurzame systemen binnen geformuleerde criteria. Uitvoering pilotprojecten en bijbehorende monitoring. Ontwerp demonstratiefase.
2010-2015	Totale 'nieuwe' import ca. 40-50 PJ in 2010.		Grootschalige demonstratie biomassaproductie voor export in bilaterale verbanden. Verdere marktontwikkeling en bijdrage aan internationaal geaccepteerde certificering. Investeringen in logistieke capaciteit aansluitende bij nieuwe conversietechnologieën (zoals 2^{e} generatie biofuels). Optimalisatie van bestaande supply ketens (inclusief transportoperaties en voorbehandelingtechnologieën) en monitoring van impacts.
2015-2020	100 PJ import in 2020.	4-4.5 Euro/GJ	Realisatie commerciële biomassaproductie voor export door diversiteit aan marktpartijen.
2020-2040	250 PJ in 2030, 600 PJ in 2040, afvlakken groei naar 800 PJ in 2050.	Biomassaproductie in de regio onder 2 Euro/GJ. Intermediaire producten: 3-4 Euro/GJ.	Geleidelijk versnellende opbouw productie (S-curve), logistieke en importcapaciteit, van bilaterale programma's naar volwaardige internationale handel. Sterke positie diverse Nederlandse sectoren (transport, landbouw/bosbouw, certificering en handel, conversiecapaciteit Nederlandse zeehavens)

6. Kosten & baten

Een cruciale vraag is wat de ontwikkeling van grootschalige, en duurzame, import van biomassa en biofuels Nederland kan of gaat kosten en wat een dergelijke ontwikkeling mogelijk op langere termijn kan opleveren.
Op voorhand zijn internationale ontwikkelingen (fossiele energieprijzen, ontwikkelingen voedselvraag, internationale handel) en de invloed van Nederland daarop onzeker. Huidige inzichten geven weliswaar aan dat biomassaproductie en regio's als Zuidelijk Afrika, Oost Europa en Latijns Amerika rendabel kan zijn (in vergelijking met fossiele brandstoffen), dat het technisch en zelfs economisch potentieel groot is en duurzame productie gegarandeerd zou kunnen worden. Desalniettemin is (duurzame) ontwikkeling van biomassaproductie in concrete regio's afhankelijk van veel factoren, zoals de ontwikkeling van (internationale) markten, de vraag naar voedsel en land, de mate waarin de bestaande landbouw rationaliseert en de beschikbaarheid van en type infrastructuur.

Veel hangt af van het economisch perspectief van biomassa –product ketens op langere termijn en de prijsontwikkeling van de belangrijkste alternatieven voor brandstoffen en Biomaterialen. De ontwikkeling in de aardolieprijs is daarbij de belangrijkste (onzekere) factor. In deze beschouwing wordt uitgegaan van een olieprijs van 55 U$/barrel in 2030 (rond de 8 Euro/GJ olie), die momenteel wordt aangehouden in de eind 2006 gepubliceerde World Energy Outlook ([IEA, 2006] van het International Energy Agency.

Op dit moment zijn de prijzen van landbouwproducten die worden gebruikt als grondsof voor 1e generatie biobrandstoffen, zoals suikerriet, mais, graan en palmolie, volledig afhankelijk van de voedselmarkt en vraag. Dit komt, omdat het volume wat gebruikt wordt voor biofuel productie tov voedsel nog relatief klein is.
Voor lignocellulose biomassa (uit landbouw- of bosbouwresiduen, geteeld hout of geteeld gras) geldt dit niet. Pellets (met name uit reststromen uit de bosbouw en houtverwerkende industrie) bijvoorbeeld worden op dit moment verhandeld voor prijzen van ca. 6 Euro/GJ (vergeleken met kolen voor ca. 1.5 Euro/GJ).

Het perspectief is echter dat er op mondiale schaal aanzienlijke hoeveelheden biomassa (via teelt van bomen en grassen) kunnen worden geproduceerd tegen kostprijzen van 1-2 Euro/GJ. Inclusief voorbewerking (tot bijvoorbeeld pellets, getorrificeerde biomassa of sommige vormen van bio-olie) en internationaal transport zou dat uiteindelijk kostprijzen tussen 3-4 Euro/GJ aangeleverd in Europa kunnen opleveren. Gecombineerd met geavanceerde conversietechnologie voor 2e generatie biobrandstoffen (ethanol via hydrolyse, grootschalige vergassing voor productie van synfuels) kan dat productiekosten opleveren tussen de 7-9 Euro/GJ brandstof. Dit kan concurrerend zijn met benzine of diesel uit aardolie vanaf circa 40-50 U$/barrel; een prijsniveau wat zonder meer verwacht wordt rond 2030 [IEA, 2006].
Concurrentie met kolen (rond de 1.5 Euro/GJ, naar verwachting richting 2 Euro/GJ rond 2030) ligt ook op langere termijn moeilijker, alhoewel toepassing van CO2 afvang en/of een relatief hoge CO2 prijs, de netto kosten van kolen dicht in de buurt van geïmporteerde biomassa kan brengen.

Onzeker is wanneer dergelijke kostprijzen, afhankelijk van tijdstip van commerciële toepassing van technologieën, schaal van de markt en leerprocessen zullen worden behaald. Deze factoren zijn op hun beurt weer afhankelijk van stabiel beleid en reductie van risico's voor investeerders.

6.1 Kosten

Onderstaande tabel 4 geeft, ondanks genoemde onzekerheden, een indicatie van kosten en mogelijke benefits van ontwikkeling van grootschalige import van biomassa voor vervanging van aardolie en aardgas (voor brandstoffen, feedstock voor Biomaterialen en in beperkte mate elektriciteitsproductie) na 2030. Twee uitgangspunten zijn gehanteerd:

- De invoer van biomassa neemt geleidelijk aan toe van 40 PJ in 2010, 100 PJ in 2020, 300 PJ in 2030, tot 600-800 PJ in 2040 en daarna.
- Er is uitgegaan van import van (voorbewerkte) lignocellulose biomassa van verschillende bronnen, startend op een prijspeil van 5 Euro/GJ in 2010, 4,5 Euro/GJ in 2020, 4 Euro/GJ in 2030 en 3 Euro/GJ in 2040, versus een stabiel prijspeil van 55 U$/barrel over diezelfde periode (ca. 8 Euro/GJ aardolie)

Tabel 4: Globaal overzicht van geschatte kosten voor realisatie van grootschalige duurzame biomassaproductie en importcapaciteit in de transitieperiode tot circa 2020.

Kostenpost	Bedrag	Periode	Toelichting
Fundamenteel en toegepast onderzoek	50 MEuro	2007 - 2013	Flankerend onderzoek tav impacts en duurzaamheid biomassa, ontwerp van een portfolio aan productiesystemen, monitoring, technologiedemonstratie voorbehandeling, etc. Opbouwen bilaterale samenwerkingsverbanden met productieregio's.
Pilots export regio's	100 MEuro	2008-2014	Projecten voor testen teelt en integratie in landbouw, gedegradeerde grond en specifieke reststromen + ketenorganisatie en certificering. Gelokaliseerd in ca. 3-4 sleutelregio's.
Demonstratiefase	150 MEuro	2010-2016	Opschalen pilots naar demonstratieschaal.
Marktondersteuning	2,200 MEuro (ca. 180 MEuro/jaar)	2008-2020; na 2020 rendabele toepassing voor biofuels and Biomaterialen.	Subsidiering onrendabele top, tov fossiele alternatieven; financiering conform duurzaamheidcriteria. Geleidelijk afnemende financiering in de tijd van ca. 3 Euro/GJ in 2008 tot 0.5 Euro/GJ rond 2018.
Totaal	2,500 MEuro	2007-2020 (ca. 190 MEuro/jaar)	

6.2 Baten

Naast investeringen zijn er ook te verwachten economische voordelen van zich ontwikkelende biomassa-importen in de tijd. De volgende aspecten kunnen worden onderscheiden (al dan niet in grootteorde kwantificeerbaar):

Spin-off relevante economische sectoren

Realisatie van grootschalige capaciteit voor (duurzame) biomassaproductie in regio's buiten (West) Europa biedt kansen voor sectoren als logistiek en handel, technologie (teeltconcepten, gewasveredeling, geavanceerde voorbehandelingtechnologie), consultancy en certificering. Van de verwachtte omzet voor biomassa-import (inclusief productiekosten & uitgaven voor biomassaproductie in de exporterende regio's) die 2 – 3 Miljard Euro per jaar kunnen bedragen in de periode 203-2040, zou een significant deel van die uitgaven kunnen plaatsvinden via Nederlandse bedrijven, of samenwerkingsverbanden van Nederlandse met buitenlandse bedrijven. Met name op het terrein van internationale logistiek en handel, certificering en commerciële dienstverlening zou biomassahandel tot significant hogere economische activiteit kunnen leiden vergeleken met import van fossiele brandstoffen.

Deze notitie gaat niet in op de mogelijke spin-offs van ontwikkeling en commercialisering van conversiecapaciteit (in Nederland), zoals bioraffinage, grootschalige synthesegasproductie, etc. Deze aspecten zijn in andere paden van het Platform Groene Grondstoffen behandeld (zie o.m, [Bruggink et al., 2006] en [van der Wielen et al., 2006]). Echter, de relatieve kapitaalsintensieve keten van biofuels en Biomaterialen versus op olie (en gas) gebaseerde energie- en materiaalproductie zorgen voor relatief gunstige effecten van bioraffinage versus aardolieraffinage of gasgebruik. Deze effecten kunnen nader te worden gekwantificeerd middels macro-economische scenario- analyse. Dit valt echter buiten de reikwijdte van deze notitie.

Macro-economisch

1. Grotere diversiteit in de primaire energiemix: Biomassa-importen op een niveau van 600-800 PJ per jaar rond 2040, zouden rond een kwart van de Nederlandse energievraag moeten dekken. Inclusief binnenlandse resources zou biomassa ca. 1/3 van de nationale energievoorziening voor haar rekening nemen. Biomassa zal vooral olie en in mindere mate aardgas kunnen vervangen en kan afkomstig zijn uit een groot aantal regio's in de wereld. In principe leidt dit tot een grotere diversiteit van te gebruiken primaire energiedragers met naar verwachting tot een grotere prijsstabiliteit van biomassa vergeleken met aardolie en gas. Zonder macro-economische analyses is het moeilijk de waarde van deze verwachte effecten te schatten, maar historisch zijn stabiele energieprijzen van wezenlijk belang voor stabiele economische groei. Stabilisatie van energieprijzen door biomassa-importen dient dus te worden vertaald in indirect macro-economische voordelen.
2. Potentieel lagere energieprijzen op langere termijn: Met name afhankelijk van de olieprijs, maar ook van de biomassaprijzen en mate van technologieontwikkeling kunnen prijsverschillen ontstaan van tientallen procenten tussen energiedragers en materialen uit fossiele brandstoffen (brandstof uit aardolie) versus biomassa (biofuels). Bij 55 U$/vat en geschetste productiekosten voor voorbewerkte, geïmporteerde biomassa kunnen prijsverschillen tot ca. 1 Euro/GJ brandstof in het voordeel van biofuels worden gerealiseerd. Dit kan, vanaf 2030, leiden tot lagere uitgaven voor energie (en grondstof) van 0.5 tot 1 miljard Euro/jaar.
3. Impacts op de handelsbalans: ervan uitgaande dat biomassa in de eerste plaats aardolie (en mindere mate gas en kolen) zal vervangen, is een verschuiving te verwachten in de Nederlandse handelsbalans na 2030. Cruciaal is dat aardgas tegen die tijd in toenemende mate vermoedelijk rond 2040 grotendeels zal moeten worden geïmporteerd. Als eerder aangegeven, zal olie naar verwachting iig rond de 8 Euro/GJ kosten op de wereldmarkt. Biomassa-importen van 3-4 Euro/GJ leiden tot een verlaging van de uitgaven voor energie-import vergeleken met aardolie en in mindere mate vergeleken met gas. Rond 2040 kan dat zijn opgelopen tot ca. 2.5 – 4 Miljard Euro per jaar.
4. Reductie CO2 emissies versus emissiehandel: naast potentiële prijsverschillen tussen biomassa en fossiele energie zijn de lagere broeikasgasemissies van biomassagebruik (naar verwachting ca. 90% tov fossiele referenties voor lignocellulose biomassa) een economisch voordeel. Import van 600-800PJ biomassa per jaar kan emissiereducties tussen de 40-60 Mton CO2/jaar vertegenwoordigen. Bij een aangenomen CO2 prijs in Europa van ca. 25 Euro/ton CO2, vertegenwoordigd dat een waarde van 1-1.5 Miljard Euro per jaar middels

uitgespaarde CO2 emissies. (hierbij wordt geen rekening gehouden met potentiële voordelen van cascadering van biomassa, maar ook niet met de lagere conversie-efficiency van biomassa naar brandstoffen versus olie en gas).

Naast de moeilijk te kwantificeren waarde van een meer diverse mix van energie-importen bedragen de bij benadering geschatte economische baten van biomassa-import tov een referentiesituatie gebaseerd op fossiele energie enkele miljarden Euro per jaar. Deze schatting is grof, niet vergeleken met andere strategieën om emissiereducties te behalen en niet berekend mbv macro-economische modellen, maar geeft wel aan wat bij benadering belang is van deze optie. Ook rechtvaardigen dergelijke langtermijn voordelen wezenlijke investeringen op korte en middellange termijn.

7. Samenvatting & aanbevelingen

7.1 Relevantie

Biomassa is de belangrijkste hernieuwbare energiebron voor de komende decennia, wereldwijd, in Europa en in Nederland. Huidige inzichten in de (mondiale) potenties van biomassa halverwege deze eeuw geven aan dat een biomassa rond een derde van de toekomstige wereldenergievraag zou kunnen dekken, een vergelijkbare rol als die minerale olie nu vervult. De visie die het Platform Groene Grondstoffen voor Nederland tav de bijdrage van biomassa heeft neergelegd omvat een bijdrage van biomassa van 30% aan de nationale energie- en materiaalvoorziening na 2030, ofwel rond de 1000 PJ primaire energie. Daarmee wordt van biomassa een cruciale bijdrage verwacht aan de doelstelling van de energietransitie en is de grootste bijdrage aan reductie van CO2 emissies, vermindering van importen van fossiele brandstoffen (ihb olie) en vervult een sleutelrol in het 'vergroenen' van de transportsector en chemische industrie middels (2^{e} generatie) biobrandstoffen en groene feedstock. Gegeven dat de nationale potenties van biomassa (bv. uit residuen, organisch afval en geteelde biomassa) beperkt zijn tot enkele honderden PJ's, zal de bulk van de groei van de inzet van biomassa moeten komen uit importen. Recentelijk is geïmporteerde biomassa al verantwoordelijk geweest voor het grootste deel van de groei in het biomassagebruik voor energie in Nederland. Het (verwachte) groeiende gebruik van biobrandstoffen in de transportsector zal die trend verder doen doorzetten.

Op dit moment is de belangrijkste vraag hoe de duurzaamheid van grootschalige biomassa productie elders in de wereld kan worden gegarandeerd. De door de Nederlandse overheid ingestelde werkgroep Duurzame Biomassa Productie ('Commissie Cramer') heeft in 2006 een basis gelegd voor duurzaamheidcriteria voor biomassa-importen. De in dit document geschetste roadmap voor het ontwikkelen van een duurzame en economisch vitale biomassa importsector, onderschrijft de aanbevelingen van deze werkgroep en doet voorstellen voor concrete uitwerking toepassing middels pilot, demonstratie en marktontwikkeling.

De beschreven activiteiten zijn van internationaal belang. Internationale bio-energie markten ontwikkelen zich snel, maar deels ook ongecontroleerd. Het op (en uit-)bouwen van ervaring, zeker met verduurzamen van biomassaproductie kan een Nederland een leidende positie geven op die nog jonge internationale markt. Dit biedt kansen voor belangrijke economische sectoren als logistiek, de energiesector, land- en bosbouw, handel en certificering en consultancy. In grote delen van de 'value chains' die kunnen worden geschetst kunnen Nederlandse bedrijven een wezenlijke rol spelen. De verwachtte bijdragen van biomassa-importen aan de toekomstige energievoorziening als geschetst in de visie van het Platform Groene Grondstoffen vertegenwoordigen een waarde van 1,5 – 3 miljard Euro per jaar.
Belangrijker is dat het zo snel mogelijk opbouwen van (commerciële) ervaring voor het duurzaam produceren en verhandelen en certificeren van elders geproduceerde biomassa internationaal een belangrijke voorbeeldfunctie kan vervullen. De kansen, alsmede de punten van zorg over biomassa worden eveneens benadrukt door andere (met name Europese) landen en internationale instellingen als FAO, UNCTAD en UNIDO. De diverse agenda's bevestigen de noodzaak voor de activiteiten die in deze roadmap zijn omschreven.

Import van biomassa (of energiedragers geproduceerd uit biomassa) is van fundamenteel belang voor het halen van de transitiedoelstellingen. Met een verwacht aandeel van 600-800 PJ in 2040 krijgt biomassa een rol die vergelijkbaar is als minerale olie op dit moment. Huidige inzichten geven

aan dat biomassaproductie en regio's als Zuidelijk Afrika, Oost Europa en Latijns Amerika rendabel kan zijn (in vergelijking met fossiele brandstoffen), dat het technisch en economisch potentieel groot is en duurzame productie gegarandeerd zou kunnen worden. Desalniettemin is (duurzame) ontwikkeling van biomassaproductie in concrete regio's afhankelijk van veel factoren, zoals de ontwikkeling van (internationale) markten, de vraag naar voedsel en land, de mate waarin de bestaande landbouw rationaliseert en de beschikbaarheid van en type infrastructuur.
Het perspectief is echter dat er op mondiale schaal aanzienlijke hoeveelheden biomassa (via teelt van bomen en grassen) kunnen worden geproduceerd tegen kostprijzen van 1-2 Euro/GJ. Inclusief voorbewerking (tot bijvoorbeeld pellets, getorrificeerde biomassa of sommige vormen van bio-olie) en internationaal transport zou dat uiteindelijk kostprijzen tussen 3-4 Euro/GJ aangeleverd in Europa kunnen opleveren. Gecombineerd met geavanceerde conversietechnologie voor 2^{e} generatie biobrandstoffen (ethanol via hydrolyse, grootschalige vergassing voor productie van synfuels) kan dat productiekosten opleveren tussen de 6-9 Euro/GJ brandstof. Dit zou concurrerend zijn met benzine of diesel uit aardolie vanaf circa 40-50 U$/barrel; een prijsniveau wat zonder meer verwacht wordt rond 2030 (IEA). Concurrentie met kolen (rond de 1.5 Euro/GJ) ligt ook op langere termijn moeilijker, alhoewel toepassing van CO2 afvang en/of een relatief hoge CO2 prijs, de netto kosten van kolen dicht in de buurt van geïmporteerde biomassa kan brengen.

7.2 Ontwikkeling, kosten en baten:
Voor het realiseren van grootschalige biomassaproductie en importcapaciteit zijn een aantal belangrijke activiteiten onderscheiden:

1. Flankerend onderzoek tav impacts en duurzaamheid biomassa, ontwerp productiesystemen, monitoring, technologiedemonstratie voorbehandeling, etc.
2. Projecten voor testen teelt en integratie in landbouw, gedegradeerde grond en specifieke reststromen + ketenorganisatie en certificering
3. Opschalen pilots naar demonstratieschaal
4. Subsidiering onrendabele top voor geïmporteerde biomassa ; financiering conform duurzaamheidcriteria. Geleidelijk afnemende financiering in de tijd van ca. 3 Euro/GJ in 2008 tot 0.5 Euro/GJ rond 2018 en afschaffing subsidiering na 2020.

De geschatte kosten voor onderzoek en demonstratieactiviteiten bedragen tot 2020 circa 300 Miljoen Euro (subsidie). De geschatte kosten voor marktondersteuning vergen in diezelfde periode naar schatting 2,2 Miljard Euro. In totaal bedragen de kosten tot en met 2020 circa 180 miljoen Euro per jaar.
Voor deze schattingen zijn twee uitgangspunten zijn gehanteerd:

- De invoer van biomassa neemt geleidelijk toe van 40 PJ in 2010, 100 PJ in 2020, 300 PJ in 2030, tot 600-800 PJ in 2040 en daarna.
- Er is uitgegaan van import van (voorbewerkte) lignocellulose biomassa van verschillende bronnen, startend op een prijspeil van 5 Euro/GJ in 2010, afnemend naar uiteindelijk 3 Euro/GJ in 2040.

Van de verwachtte omzet voor biomassa-import (inclusief productiekosten & uitgaven voor biomassaproductie in de exporterende regio's) die 2 – 3 Miljard Euro per jaar kunnen bedragen in de periode 2030-2040 kan een significant deel worden gerealiseerd via Nederlandse bedrijven, of samenwerkingsverbanden van Nederlandse met buitenlandse bedrijven. Met name op het terrein van internationale logistiek en handel, certificering en commerciële dienstverlening zou biomassahandel tot significant hogere economische activiteit kunnen leiden vergeleken met import van fossiele brandstoffen. De relatieve kapitaalsintensieve keten van biofuels en Biomaterialen versus op olie (en gas) gebaseerde energie- en materiaalproductie zorgen voor relatief gunstige effecten van bioraffinage versus aardolieraffinage of gasgebruik. Positieve gevolgen betreffen: Grotere diversiteit in de primaire energiemix, op termijn lagere energieprijzen ten opzichte van fossiele brandstoffen kunnen leiden tot lagere uitgaven voor (geïmporteerde) energie van 0.5 tot 1 miljard Euro/jaar. Positieve impacts op de handelsbalans vergeleken met aardolie (en in mindere mate gas), kunnen rond 2040 oplopen tot ca. 2.5 – 4 Miljard Euro per jaar. Reductie CO2 emissies versus emissiehandel: emissiereducties tussen de 40-60 Mton CO2/jaar voor biomassa-importen vertegenwoordigd een waarde van 1-1.5 Miljard Euro (bij 25 Euro/ton CO2).

7.3 Wat moet er gebeuren?

- Verdere uitwerking en toepassing van het criteriaraamwerk als betoogd door de projectgroep duurzame productie biomassa; opbouwen van de noodzakelijke wetenschappelijke kennisbasis, voor ontwerpen en monitoren van duurzame biomassaproductiesystemen onder verschillende omstandigheden. Initiëren Programma Flankerend Wetenschappelijk onderzoek tbv ontwikkeling indicatoren, monitoringmethodieken en ontwerpmethodieken voor duurzame biomassaproductie.
- Daarmee direct samenhangend het opzetten van een coherente set pilots en demo's voor opzetten en bedrijven van duurzame biomassa productie en aanvoerketens. Opbouwen van ervaringen onder verschillende omstandigheden. Demonstreren duurzaamheidraamwerk. Coherent programma van ca. 10 jaar. Mede ontwikkelingen mbv bilaterale samenwerkingsprogramma's.
- Internationale dialoog over certificering en opbouwen internationaal draagvlak: EC, belangrijke partnerlanden in EU, WTO, UN, NGO's; opzetten roundtable duurzame biomassaproductie en handel.
- Stabiele beleidsstrategie tav biomassa-import over een periode van 10-15 jaar; heldere stellingname tav toepassing en uitwerking van duurzaamheidcriteria en daaraan gekoppelde financiële ondersteuning (en het in de tijd afbouwen daarvan). Flexibel financieel instrumentarium in de tijd.
- Multidepartmentaal gedragen en met, financiële bijdragen vanuit de verschillende beleidsterreinen (energie, milieu/klimaat, transport, landbouw en int. Samenwerking. Bilaterale samenwerkingsovereenkomsten met selectie van regio's (ism Buitenlandse Zaken)
- Directe betrokkenheid van Nederlandse/multinationale partijen in logistiek, certificering, handel, energiesector, landbouw & bosbouw. Deels ook technologie en kennisleveranciers tbv opzetten en vermarkten van biomassaproductie en supply ketens. Investeringen in logistieke capaciteit en conversiecapaciteit (bij voorkeur flexfuel).
- Doelen en strategie formuleren voor het opbouwen van een vitale biomassa-import sector voor de BV Nederland.

De realisatie van grootschalige duurzame biomassaproductie en importcapaciteit is een zaak van lange adem. Naar verwachting is een traject tot 2020 nodig om op wezenlijke schaal en voor een diversiteit aan relevante biomassastromen en productieregio's afdoende ervaring op te doen. Ervaring met pilot- en demonstratieactiviteiten, duurzaam ontwerpen en beheren, participatieve benaderingen en businessmodellen moeten de kennisbasis, draagvlak en ervaring leveren om een vitale economische sector op te bouwen. De overheid vervult een sleutelrol in het commitment en bewaken van een dergelijk langere termijn traject. Het realiseren van een coherent nationaal onderzoeks- en demonstratieprogramma met als kern biomassaproductie pilots en exportketens in diverse partnerlanden is een eerste cruciale stap. Tegelijkertijd dienen middels financiële instrumenten, die in de tijd geleidelijk worden afgebouwd, een stabiele markt voor geïmporteerde biomassa te worden gegarandeerd. De overheid is hier primair voor verantwoordelijk. Het is aan de markt om de activiteiten in samenwerking en in een coherent programma uit te werken en een business op te bouwen. Een public-private partnership, met een prominente rol voor partners in de producerende regio's is daarvoor een geëigende weg.

Referenties

[Bruggink, 2006] A. Bruggink, *Nieuwe bronnen voor chemie*, Platform Groene Grondstoffen, September 2006.

[van Dam et al., 2006] J. van Dam, M. Junginger, A. Faaij, I. Juergens, G. Best; *Overview of recent developments in sustainable biomass certification* Paper written within the frame of IEA Bioenergy Task 40, December 2006.

[DPB, 2006] J. Cramer, et al., *Criteria voor Duurzame Biomassa Productie*; Eindrapport van de Projectgroep Duurzame Productie van Biomassa, Ministerie van Economische Zaken, Den Haag, 14 Juli 2006, Pp. 56

[Faaij & Domac, 2006] A. Faaij, J. Domac, *Emerging international bio-energy markets and opportunities for socio-economic development,* Energy for Sustainable Development (Special Issue

on Emerging International Bio-energy markets and opportunities for socio-economic development), Vol X. No.1, March 2006. Pp. 7-19

[Fritsche & Hunecke, 2006] Fritsche and K. Hunecke, Sustainability standards for bioenergy. Darmstadt, Oko
institut, commissioned by WWF Germany, 2006

[GGL, 2006] Certifications, Control Union (2006). Green Gold Label certification programme.

[Hamelinck et al., 2005] C. N. Hamelinck, R. Suurs, A. Faaij, *Techno-economic analysis of International Bio-energy Trade Chains*. Biomass & Bioenergy, Vol. 29, Issue 2, August 2005, Pages 114-134

[Hoogwijk et al., 2005] Monique Hoogwijk, André Faaij, Bas Eickhout, Bert de Vries, Wim Turkenburg, *Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios,* Biomass & Bioenergy, Vol. 29, Issue 4, October 2005, Pages 225-257.

[IPCC, 2007] IPCC, 4th Assessment report; various chapters on bio-energy (Agriculture, Forestry, Energy Supply, Transport, Integration of mitigation potentials) (Final Draft, Janaury 2007) *Integration mitigation potentials*; Intergovernmental Panel on Climate Change (IPCC) (publication: 2007)

[Junginger & Faaij, 2005] M. Junginger, A. Faaij*, IEA Bioenergy task 40 - Country report for the Netherlands*, Copernicus Institute, Department of Science, Technology & Society, Utrecht University. Reportno: NWS-E-2005, July 2005. Pp. 30

[Lewandowski & Faaij, 2006] I. Lewandowski, A. Faaij, *Steps towards the development of a certification system for sustainable bio-energy trade*, Biomass & Bio-energy, Volume 30, Issue 2, February 2006, Pages 83-104

[PGG, 2006] Platform Groene Grondstoffen; Eindadvies, Oktober 2006.

[Sanders et al., 2006] Duurzame productie & ontwikkeling van biomassa (zowel in Nederland als in het buitenland). Werkgroep duurzame productie en ontwikkeling van biomassa van het platform groene grondstoffen. Juli 2006.

[Sark et al., 2006] W. van Sark, M. Patel, A. Faaij, *The potential of renewables as a feedstock for Chemistry and Industry*. Chapter 2 in: Renewable-Based Technology: Sustainability Assessment, Jo Dewulf and Herman van Langenhove (eds.), Published by: John Wiley & Sons, ISBN: 0-470-02241-8. March 2006. Pp. 19-37

[Smeets, et al., 2006] Edward M.W. Smeets, André P.C. Faaij, Iris M. Lewandowski, Wim C. Turkenburg, *A quickscan of global bio-energy potentials to 2050.* Progress in Energy and Combustion Science, Volume 33, Issue 1, February 2007, Pages 56-106

[van der Wielen et al., 2006] Potential of co-production of energy, fuels and chemicals from biobased renewable resources. WISEBIOMAS, Working Group for Innovative and Sustainable Biobased Energy and Materials of the Platform Groene Grondstoffen. November 2006.

[WWF, 2006]. WWF Position on Biofuels in the EU. Brussels, WWF European Policy Office.

[WWI, 2007] *"Biofuels for Transport: Global Potential and Implications for Energy and Agriculture"* prepared by Worldwatch Institute, for the German Ministry of Food, Agriculture and Consumer Protection (BMELV) in coordination with the German Agency for Technical Cooperation (GTZ) and the German Agency of Renewable Resources (FNR), ISBN: 1844074226, Published by EarthScan/James & James, April 2007 Pp. 336

[Zarrilli, S., 2006]. The emerging biofuels market: regulatory, trade and development implications. Geneva,United Nations Conference on Trade and Development (UNCTAD).

Appendix I: Een overzicht van de state-of-the art kennis tav biomassapotentiëlen

De onderstaande tekst [zie ook: Faaij & Domac, 2006 en Hunt et al.,2007] grotendeels geschreven voor de volgende boekpublicatie:

One generally uses four different categories of renewable energy potential, including bio-energy:

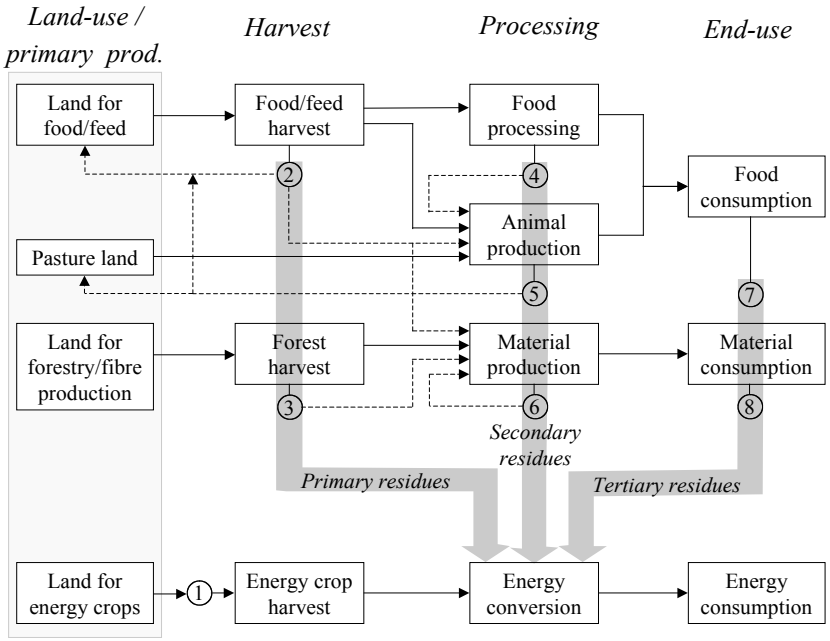
- *Theoretical* potential: the theoretical limit of the primary resource;
- *Geographical* potential: the theoretical potential reduced by geographical constraints, i.e., areas which are considered available and/or (partly) suitable;
- *Technical* potential: the geographical potential reduced by losses associated with the conversion from the primary to the secondary resource;
- *Economic* potential: the technical potential possible at cost levels that are competitive with other conversion routes;

In addition, of further interest is the *implementation* potential, which is the total amount of technical potential that is implemented in the energy system. This can be influenced by various incentives and societal perception to be higher than the economic potential.

Figure. Schematic overview of the present terrestrial biomass flows in the food, materials, and bio energy sectors, as well as in final end use. The grey arrows denote: 1) energy crops, 2) agricultural residues, 3) forest residues, 4) food residues, 5) manure, 6) non-food organic waste, 7) food consumption waste, 8) non-food consumption waste.

The potential for bio-energy on longer term

This section focuses on the potential availability of biomass resources for energy and materials. It



briefly discusses the various resource categories: residues from forestry and agriculture, various organic waste streams and, most important, the possibilities for active biomass production on various land categories (e.g. for wood plantations or energy crops as sugar cane).

Biomass residues potential availability is discussed below. These may be divided into:

- *Primary residues:* residues generated pre- and at harvest of main product, e.g. tops and leaves of sugar cane.
- *Secondary residues:* residues generated in processing to make products, e.g. bagasse, rice husks, black liquor.
- *Tertiary residues:* residues generated during- and post end use (+ non-used products), e.g. demolition wood, municipal solid waste.

In general, biomass residues (and wastes) are intertwined with a complex of markets. Many residues have useful applications such as fodder, fertilizer and soil conditioner, raw material for,

e.g., particle board, Medium Density Fibre board (MDF) and recycled paper, etc. Net availability as well as (market) prices of biomass residues and wastes therefore generally depend on market demand, local as well as international markets for various raw material and on the type of waste treatment technology deployed for remaining material. The latter is particularly relevant when tipping fees are deployed, giving some organic waste streams a (theoretical) negative value. Typically, the net availability of organic wastes and residues can fluctuate and is influenced by market developments, but also on climate (high and low production years in agriculture) and other factors.

Biomass Supplies

Biomass residues and organic wastes

Residues from agriculture: Estimates are available from various studies. Potential depends on yield/product ratios and the total agricultural land area as well as type of production system. Less intensive management systems require re-use of residues for maintaining soil fertility. Intensively managed systems allow for higher utilisation rates of residues but also usually deploy crops with lower crop to residue ratios.
Estimates vary between some 15 up to 70 EJ per year. The latter figure is based on the regional *production* of food (in 2003) multiplied by harvesting or processing factors and the assumed recoverability factors [Smeets et al., 2004]. These figures do not subtract the potential alternative use for agricultural residues. As indicated by [Junginger et al., 2001], competing applications can reduce the net availability of agricultural residues for energy or materials significantly.

Dung: this category especially concerns the use of dried dung. Total estimated contribution could be 5-55 EJ worldwide. The low estimate based on global current use, the high estimate is the technical potential. Utilisation (collection) on longer term is uncertain because this is particularly considered a poor man's fuel [Faaij et al., 2000].

Organic Wastes: This category includes the organic fraction of Municipal Solid Waste and waste wood (e.g., demolition wood). Estimates on the basis of literature values strongly dependent on assumptions on economic development, consumption and the use of biomaterials; the ranges projected for MSW on longer term (e.g., beyond 2040) amount to 5-50 EJ. Higher values are possible when more intensive use is made of biomaterials [Fischer and Schrattenholzer,].

Forest residues: The (sustainable) energy potential of the world's forests is partly uncertain. A recent evaluation of forest reserves and development of demand for wood products concluded that: even in the case of the highest wood demand projections found in literature, the demand can (in theory) be met without further deforestation. The bio energy potential from forestry can contribute 1 to 98 EJ/y of surplus natural forest growth and 32 to 52 EJ/y harvesting and processing residues in 2050. The most promising regions are the Caribbean and Latin America, the former Soviet Union and partially North America. Key variables are the demand for industrial round wood and fuel wood, plantation establishment rates, natural forest growth and the impact of technology and recycling [Smeets et al., 2005].

The potential for energy crops

LAND USE FOR ENERGY PRODUCTION

Biomass production requires land. Relatively conservatively, the productivity for a perennial crop (like Willow, Eucalyptus or Switch grass) lies between 8 - 12 tonnes dry matter per hectare per year. The heating value of dry clean wood amounts about 18 GJ/tonne (LHV). One hectare can therefore produce about 140 - 220 GJ/ha*yr. (gross energy yield, energy inputs for cultivation, fertiliser, harvest, etc amount about 5%).
1 PJ would require 4,500 - 7,000 ha. 1,500 MWth (the amount of fuel needed to fire a base load power plant with 40% efficiency of 600 MWe) would require 140,000 - 230,000 ha, and 100 EJ (about one quarter of the world's current energy use) would ask 450 - 700 Mha.

Clearly, active biomass production requires land. The potential for energy crops therefore largely depends on land availability considering that worldwide a growing demand for food has to be met, combined with nature protection, sustainable management of soils and water reserves and a variety

of other sustainability criteria. Given that a major part of the future biomass resource availability for energy and materials depend on these (intertwined, uncertain and partially policy dependent) factors, it is impossible to present the future biomass potential in one simple figure. A review of available studies of future biomass availability carried out in 2002 (17 in total) revealed that no complete integrated assessment and scenario studies were available by than [Berndes et al., 2003]. These studies were amongst others carried out for and by: IPCC, US EPA, World Energy Council, Shell, Stockholm Environmental Institute a.o.

Figure 1 summarizes the main findings. It is concluded that: the studies arrived at widely different conclusions about the possible contribution of biomass in the future global energy supply (e.g., from below 100 EJ yr^{-1} to above 400 EJ yr^{-1} in 2050). The major reason for the differences is that the two most crucial parameters—land availability and yield levels in energy crop production—are very uncertain, and subject to widely different opinions (e.g., the assessed 2050 plantation supply ranges from below 50 EJ yr^{-1} to almost 240 EJ yr^{-1}). However, also the expectations about future availability of forest wood and of residues from agriculture and forestry vary substantially among the studies.

The question how an expanding bio energy sector would interact with other land uses, such as food production, biodiversity, soil and nature conservation, and carbon sequestration has been insufficiently analyzed in the studies. A refined modelling of interactions between different uses and bio energy, food and materials production—i.e., of competition for resources, and of synergies between different uses—would facilitate an improved understanding of the prospects for large-scale bio energy and of future land-use and biomass management in general

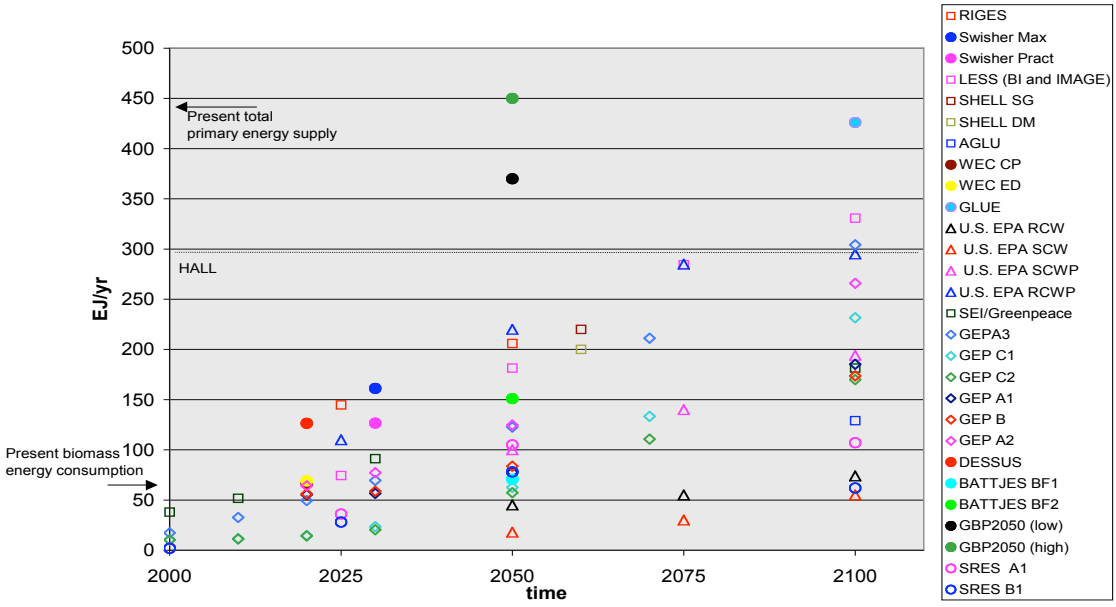


Figure: Results of a review of 17 studies [Berndes et al., 2003] projecting biomass potentials up to the year 2100, expressed in EJ.

State-of-the-art insights

Recently, these issues were addressed in several studies. One approach is reported in [Smeets et al., 2004] where bottom-up information was used on land-use, agricultural management systems on a country-by-country basis, projections for demand for food and information on possible improvements in agricultural management (both for crops and production of meat and diary products).

In this study a methodology and results of a *bottom-up analysis* of the *global technical bio energy production potential* (aggregated in regions) in 2050 is developed and presented[4]. Included in this study are:

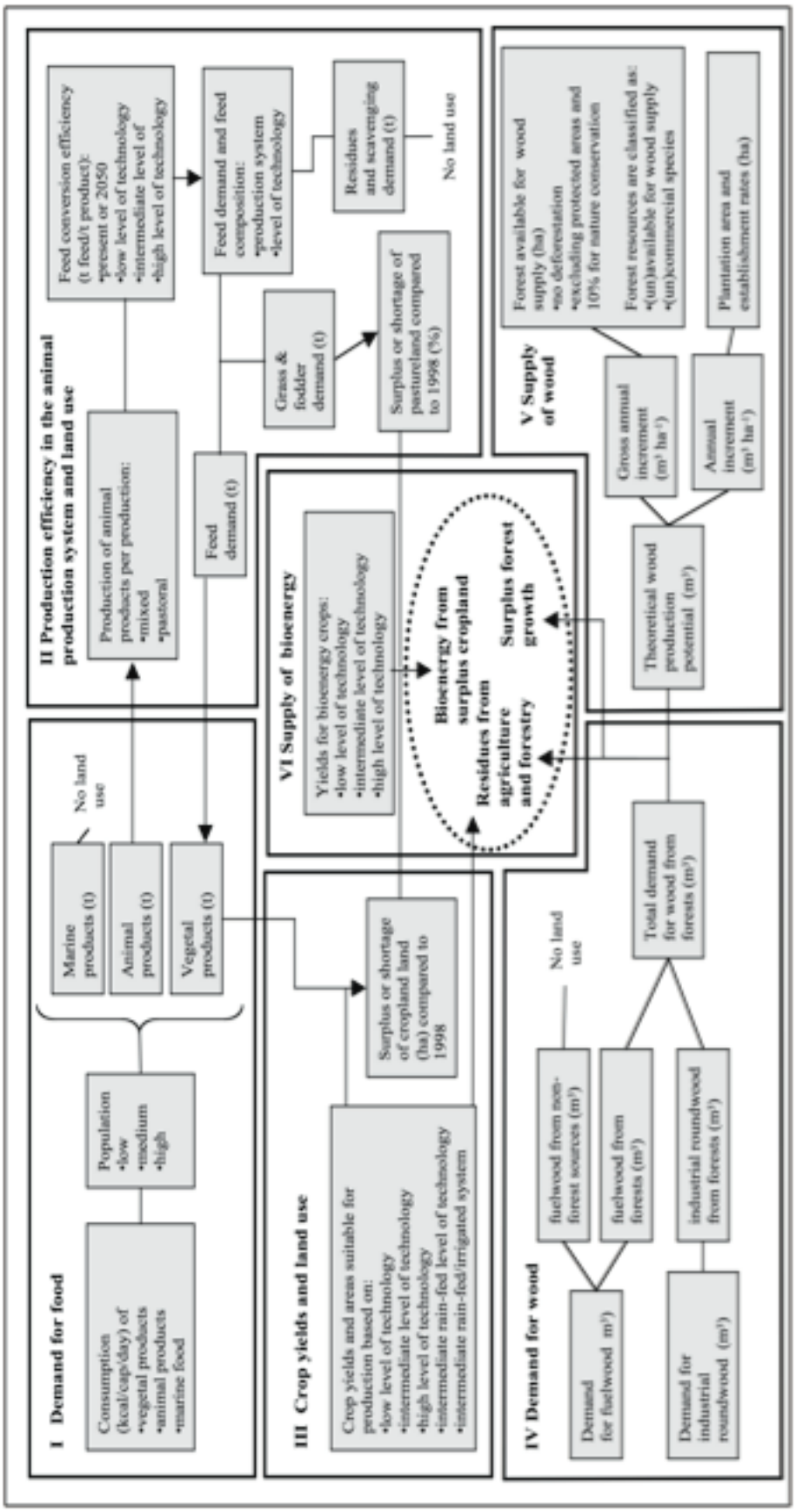
[4] This study is part of the FairBiotrade project which is funded by the Dutch electricity company Essent N.V. and NOVEM (Netherlands Organisation for Energy and the Environment).

- The *best available knowledge* from extensive study of existing databases, scenarios and studies.
- The impact on gaps and weak spots in the *knowledge base*. Existing studies frequently ignore or only partially identify weak spots in the knowledge base, data from existing studies and the interaction between existing studies.
- The impact of (most important) *underlying factors* that determine the bio energy production potential.
- The impact of *sustainability criteria* such as avoidance of deforestation and competition for land between bio energy production and food production and protection of biodiversity and nature conservation.

Three bio energy sources are included in this study: residues from the agricultural sector and forestry industry, surplus wood production from forestry and bio energy from specialised energy crops. Previous studies indicate that the highest potential comes from specialised bio energy crops produced on degraded land and surplus agricultural land (0-998 EJy^{-1}). Therefore, the core focus of this study is on assessing land use patterns and how these are influenced. The production of bio energy from specialised bio energy crops is limited to *surplus land or land not suitable for agriculture*.

The key elements that determine the bio energy production potential and their correlations are identified and shown in figure 1. Future trends are analysed by means of *scenario analysis*, which allows an analysis of the impact that various parameters have on the bio energy potential. The methodology is applied here at the regional level, but can also be used at a country level.

Figure 1. Overview of key elements and correlations included in the assessment of [Smeets et al., 2004].



In one recent analyses, so-called integrated assessment based modelling was deployed. These complex modelling techniques, that interlink demographic, economic, land-use and climate and technological information enable the exploration of the geographic (technical) and economic potential for active biomass production under the different scenario assumptions.
Scenario's were taken from IPCC terminology, to describe different future worlds in terms of economic development, trade, technological progress, climate changes, etc. The four scenarios are based on storylines published by the Intergovernmental Panel on Climate Change (IPCC) in the Special Report on Emissions Scenarios (SRES) (Nakicenovic, 2000) as implemented with the IMAGE 2.2 model (IMAGEteam, 2001). The storylines describe different social, economic, technological, environmental and policy developments. Basically the four scenarios ('stories') are constructed along two dimensions, i.e. the degree of globalisation versus regionalisation, and the degree of orientation on material versus social and ecological values. The four scenarios do not have a particular order and are listed alphabetically and numerically, i.e. A1; A2; B1; B2. These scenario's hold the most important assumptions regarding food demand and supply [Hoogwijk et al., 2005].

Synthesis of findings on long term global biomass potentials:
Summarizing, both the technical and economic potential of biomass resources for energy and material use can be very large, up to over 2 times the current global energy demand, without competing with food production, protection of forests and nature. Besides residues from agriculture and forestry (which are significant, but also limited due to competing applications) and organic waste, especially active production (e.g. energy crops) of biomass is responsible for these potentials. Key however, to the development of competitive energy cropping systems is the rationalization of agriculture, especially in developing countries, which can result in considerably higher land-use efficiencies for agriculture and, thus, a surplus of productive land. Perennial crops (such as Eucalyptus, poplar, grasses as Miscanthus and sugar cane) provide the most favourable economics and environmental characteristics for biomass production. Table 1 (based on Faaij et al., 2000, Smeets et al., 2004 and Hoogwijk et al., 2005) provides a summary of the biomass categories discussed in this section.

Table 1: Overview of the global potential bio-energy supply on the long term for a number of categories and the main pre-conditions and assumptions that determine these potentials.

Biomass category	**Main assumptions and remarks**	**Potential bio-energy supply up to 2050.**
Energy farming on current agricultural land	Potential land surplus: 0-4 Gha (more average: 1-2 Gha). A large surplus requires structural adaptation of intensive agricultural production systems. When this is not feasible, the bio-energy potential could be reduced to zero as well On average higher yields are likely because of better soil quality: 8-12 dry tonne/ha*yr is assumed. (*)	0 – 700 EJ (more average development: 100 – 300 EJ)
Biomass production on marginal lands.	On a global scale a maximum land surface of 1.7 Gha could be involved. Low productivity of 2-5 dry tonne/ha*yr. (*) The supply could be low or zero due to poor economics or competition with food production.	(0) 60 – 150 EJ
Bio-materials	Range of the land area required to meet the additional global demand for bio-materials: 0.2-0.8 Gha. (average productivity: 5 dry tonnes/ha*yr). This demand should be come from category I and II in case the world's forests are unable to meet the additional demand. If they are however, the claim on (agricultural) land could be zero.	**Minus** (0) 40 –150 EJ
Residues from agriculture	Estimates from various studies. Potential depends on yield/product ratio's and the total agricultural land area as well as type of production system: Extensive production systems require re-use of residues for maintaining soil fertility. Intensive systems allow for higher utilisation rates of residues.	Approx. 15 – 70 EJ
Forest residues	The (sustainable) energy potential of the world's forests is unclear. Part is natural forest (reserves). Range is based on literature data. Low value: figure for sustainable forest management. High value: technical potential. Figures include processing residues.	(0) 30 - 150 EJ
Dung	Use of dried dung. Low estimate based on global current use. High estimate: technical potential. Utilisation (collection) on longer term is uncertain.	(0) 5 – 55 EJ

Biomass category	Main assumptions and remarks	Potential bio-energy supply up to 2050.
Organic wastes	Estimate on basis of literature values. Strongly dependent on economic development, consumption and the use of bio-materials. Figures include the organic fraction of MSW and waste wood. Higher values possible by more intensive use of bio-materials.	5 – 50 (+) EJ (**)
Total	Most pessimistic scenario: no land available for energy farming; only utilisation of residues. Most optimistic scenario: intensive agriculture concentrated on the better quality soils. (between brackets: more average potential in a world aiming for large scale utilisation of bio-energy)	**40 – 1100 EJ (250 - 500 EJ)**

(*) Heating value: 19 GJ/tonne dry matter.
(**) The energy supply of bio-materials ending up as waste can vary between 20-55 EJ (or 1100-2900 Mtonne dry matter per year (see table 4; biomass lost during conversion, such as charcoal is logically excluded from this range). This range excludes cascading and does not take into account the time delay between production of the material and 'release' as (organic) waste.

In theory, energy farming on current agricultural land could, with projected technological progress, contribute over 800 EJ, without jeopardising the world's food supply. Organic wastes and residues could possibly supply another 40-170 EJ, with uncertain contributions from forest residues and potentially a very significant role for organic waste, especially when bio-materials are used on a larger scale. In total, the upper limit the of bio-energy potential could be over 1000 EJ (per year) [Hoogwijk et al., 2003], [Smeets et al., 2004]. This is considerably more than the current global energy use of about 430 EJ

Latin America, Sub-Saharan Africa and Eastern Europe clearly are promising regions, also Oceania and East and NE Asia jump out as potential biomass production areas on the longer term. The latter can in particular be explained by the projected demographic developments (possibly declining population in China after 2030) and fast technological progress in agriculture, leading to substantial productivity increases.
These analyses also show that a large part of the technical potential for biomass production may be developed at low production costs in the range of 2 U$/GJ [Hoogwijk et al., 2004], [Smeets et al., 2005].

Major transitions are however required to exploit this bio-energy potential. Especially improving agricultural efficiency in developing countries (i.e. increasing crop yields per hectare) is a key factor. It is still uncertain to what extent and how fast such transitions can be realized in different regions. Under less favourable conditions, the (regional) bio-energy potential(s) could be quite low.
Also, it should be noted that technological developments (in conversion, as well as long distance biomass supply chains (i.e. comprising intercontinental transport of biomass derived energy carriers) can dramatically improve competitiveness and efficiency of bio-energy. Increased competitiveness is logically a driver to develop the production potentials of bio-energy.

Critical Issues:
The message from recent analyses dealing with global biomass potentials on the long term is a complex one: technical and even economic potentials can be very large and could make biomass a fundamental alternative for oil during this century. However, those potentials need to be developed to a large extent. Available residues and organic wastes from agriculture, forestry and the waste treatment sector are substantial, but also limited. The (sustainable) use of different types of land (marginal and degraded, as well as good quality agricultural and pasture land) depends on the success of accelerating the improvements in current agricultural management and integrating biomass production in a sustainable way in current land-use patterns. Our understanding of how this can be achieved from region to region is often limited. Current experiences with energy crops as Willow (in Sweden) and Sugar cane (in Brazil) give leads on how biomass production can gradually be introduced in agriculture and forestry. In developing countries (e.g. sub-Saharan Africa) very large improvements can be made in agricultural productivity given the current agricultural methods deployed (often subsistence farming), but better and more efficient agricultural methods will not be implemented without investments and proper capacity building and infrastructure improvements. Much more experience is needed with such schemes, in which the introduction of bio-energy can play a pivotal role to create more income for rural regions by additional bio-energy

production. Financial resources generated could than accelerate investments in conventional agriculture and infrastructure and also lead to improved management of agricultural land.

Critical issues that require further research and especially more regional demonstrations and experience with biomass production are:

Competition for water resources
Water is logically a critical resource for both food and biomass production and a constrained resource in many world regions. Water scarcity in relation to additional biomass production has been addressed to a limited extent (see e.g. Berndes, 2002 who concludes that Abstract
There are major expectations that bio energy will supply large amounts of CO_2 neutral energy for the future. A large-scale expansion of energy crop production would lead to a large increase in evapotranspiration appropriation for human uses, potentially as large as the present evapotranspiration from global cropland. In some countries this could lead to further enhancement of an already stressed water situation. But there are also countries where such impacts are less likely to occur. One major conclusion for future research is that assessments of bio-energy potentials need to consider restrictions from competing demand for water resources.

availability of fertilizers and pest control
Increases in agricultural productivity, in particular in DC's, can only be achieved when better management and higher productivities are achieved. This implies availability of fertilisers and pest control methods. It's use needs to be within sound limits. Sound agricultural methods (agroforestry, precision farming, biological pest control, etc.) exist that can achieve major increases in productivity with neutral or even positive environmental impacts. Such practices must however be secured by sufficient knowledge, funds and human capacity & knowledge.

land-use planning taking biodiversity and soil quality into account
Criticism is raised by various new analyses (MNP, European Environment Agency) that further intensification of agriculture and large scale production of biomass energy crops may result in a losses of biodiversity compared to current land-use, even when international standards for nature protection (10-20% of land reserved for nature) are respected. Biodiversity standards are to be interconnected with biomass production still when changes in land-use are considered. Fact is that perennial crops (which are the preferred category of crops for energy production) have a (much) better ecological profile than annual crops and benefits with respect to biodiversity can be achieved when perennial crops are displaced. However, insights in how biodiversity effects can be optimised (and improved compared to current land-use) when sound landscape planning is introduced are limited. Some indications are given by experiences in Sweden and the UK with integration of Willow production on landscape level with overall positive effects. Sao Paulo State has strict standards for sugar cane production areas and standards for original vegetation that do not necessarily lead to a loss in biodiversity. Also here, more regional efforts, experience and specific solutions are needed.

The use and conversion of pasture land connected to more intensive methods of cattle raising.
A key land category in making more efficient use of land used for food production are the world's grasslands used now for grazing. The analyses that were discussed here show that much land can be released when production of meat and diary products is done in more intensive (partly land-less in closed stables) schemes. Grasslands could than be used for production of energy grasses or partly converted to woodlands. Such changes in land-use functions are so far poorly studied, although similar conversion take place in for example Brazil. The impacts of such changes should be closely evaluated.

socio-economic impacts, in particular in rural regions.
Large scale production of modern biofuels, partly for the export market, could provide a major opportunity of many rural regions around the world to generate major economic activity, income and employment. Given the size of the global market for transport fuels, the benefits that can be achieved by reducing oil imports and possibly net exports of bio-energy are vast. Nevertheless, it is not a given that those benefits end up with the rural population and farmers that need those benefits most. Also the net impacts for a region as whole, including possible changes & improvements in agricultural production methods should be kept in mind when developing biomass and biofuel production capacity. Although various experiences around the globe (Africa-WB, Brazil, India biofuels) show that major socio-economic benefits can be achieved, new biofuel production

schemes should ensure the involvement of the regional stakeholders, in particular the farmers. Experience with such schemes needs to be built around the globe.

Macro-economic impacts of changes in land-use patterns

Although the analyses discussed indicate that both worlds' food demand and additional biomass production *can* (under relevant pre-conditions) be achieved, more intensive land-use and additional land-use for biomass production may lead to macro-economic effects on land and food prices. Although this is not necessarily a bad mechanism (it could be vital for farmers to enable investment in current production methods), the possible implications on macro-economic level are poorly understood. More analyses are needed that can highlight with what speed of implementation and change undesired economic effects can be avoided.

APPENDIX II: Overzicht van opportunities, barriers en maatregelen voor ontwikkeling van duurzame internationale handel en markten voor bio-energie

Uit: André Faaij, Martijn Wagener, Martin Junginger, Gustavo Best, Douglas Bradley, Uwe Fritsche, Angela Grassi, Bo Hektor, Jussi Heinimö, Solvar Klokk, Kees Kwant, Erik Ling, Tapio Ranta, Havar Risnes, Malgorzata Peksa, Frank Rosillo-Calle, Yves Ryckmanns, Boris Utria, Arnaldo Walter, Jeremy Woods. *Opportunities and barriers for Sustainable International bio-energy Trade; Strategic advice of IEA Task 40.* 14th European Biomass Conference and Exhibition, October 17-21, 2005, Paris-France.

1. Introduction

Essential drivers for bio energy trade are security of supply, economics, environmental (GHG mitigation and other) and development at large especially for rural areas (in developing countries). Biomass markets are developing fast, but are also immature and many barriers remain.
In some arenas a fierce debate takes place on the sustainability of large scale use of biomass and international trading. Different perspectives and strategies emerge on how biomass and bio energy markets should be governed and supported and how the sustainability of the resources and use can be secured (e.g. through certification). Securing that biomass produced in other parts of the world is supplied on a truly sustainable basis requires the development of criteria, project guidelines and a certification system that is supported on an international level.
Clearly, the strongly growing demand for biomass and biofuels make clear that there is a growing need to develop biomass resources and exploit biomass production potentials in a sustainable way. In some markets prices of biomass resources and fuels are already rising, including indirect effects on price of raw material prices for e.g. the forest industry as well as on food (e.g. sugar). Biomass markets are still immature and this is in particular true for the demand side of the market; many biomass markets, e.g. for solid fuels, rely on policy objectives and incentives, that prove to be volatile.
It is in particular important to develop both supply and demand for biomass and energy carriers derived from biomass in a balanced way and avoid distortions and instability that can threaten investments in biomass production, infrastructure and conversion capacity. Our understanding of how this is best organised and managed is still relatively poor. Biomass markets are poorly mapped and only very limited analyses work, statistics and modelling exercises are available.

2. Opportunities

Many developing countries have both a large technical agro-forestry residue potential and a large potential for dedicated energy plantations e.g. pellets or charcoal from energy plantations or ethanol from sugar cane. Given the availability of land and relatively low costs of labour in many developing countries, biomass production costs can be low, and thus offer an opportunity to export biomass to developed countries. The possibilities to export biomass derived commodities for the world's energy market can provide a stable and reliable demand for produced fuel from rural communities particularly in many developing countries, thus creating an important incentive and market access in many areas in the world.

In the past decade such trade flows have been increasing rapidly. Many trade flows are between neighbouring countries, but increasingly, long-distance trade also occurring. Examples are export of ethanol from Brazil to Japan and the EU, palm kernel shells (a residue of the palm oil production process) from Malaysia to the Netherlands, and wood pellets from e.g. Canada, Eastern Europe and Brazil to Sweden, Belgium, the Netherlands and the UK.

These trade flows may offer multiple benefits for both exporting and importing countries. For example, exporting countries may gain an interesting source of additional income and an increase in employment. Also, sound biomass production can contribute to the sustainable management of natural resources. Importing countries on the other hand may be able to fulfil cost-effectively their GHG emission reduction targets and diversify their fuel mix.

For market parties such as utilities, companies providing transport fuels, as well as parties involved in biomass production and supply (such as forestry companies), good understanding, clear criteria and identification of promising possibilities are of key interest. Investments in infrastructure and conversion capacity rely on minimization of risks of supply disruptions (in terms of volume, quality as well as price).

Biomass energy in general and international biomass trade offers many more opportunities. It is however not the main scope of this advice to highlight the. For an overview of the global theoretical potentials of biomass, see e.g. Smeets et al. (2005), for a general discussion of the potential of biomass energy see e.g. Turkenburg et al. (2000).

3. Inventory of Barriers

Based on Task 40 results, literature review and interviews, a number of potential barrier categories have been identified. These barriers may vary a great deal in terms of scope, relevance for exporting and importing countries and how stakeholders perceive it. A summary of the main barriers is given below. At the same time, it must be emphasized that depending on the reference situation, these barriers can also be opportunities. Therefore, in some cases also positive examples are included.

The categorization of the barriers is to some extent arbitrary. Some of the issues discussed under the various headings are complex and encompass elements of several barriers, e.g. logistical barriers indirectly cause economic barriers.

4.1 Economic barriers

One of *the* principal barriers for the use of biomass energy in general is the competition with fossil fuel on a direct production cost basis (i.e. excluding externalities). For example, the market price in 2004-2005 for biomass pellets in the Netherlands was about 7-7.5 €/GJ (Sambeek et al., 2004), while the cost of coal in 2005 was about 2 €/GJ. On the other hand, current production costs lie between 1-2 US$/GJ in Brazil. Thus, the high prices seem to be caused by a current constraint on the supply side.

In order to promote bio energy many developed and some developing countries have stimulated the development and use of biomass for electricity, heat and transportation by the introduction of various measures, e.g. governmental RD&D programs, tax cuts and exemptions, investment subsidies, feed-in tariffs for renewable electricity, mandatory blending for biofuels or biofuel quotas. However, an often-heard criticism from the industry is that these measures may not be sufficient (e.g. no mandatory target for the EU-25 biofuels directive), since they are mostly temporary and tend to change frequently. This discourages long-term investments, as they are considered too risky.

Due to the often small size of bio energy markets and the fact that biomass by-products are a relatively new commodity in many countries, markets can be immature and unstable. A recent example of this is the wood pellet market. During the winter of 2005/2006, the supply and demand in the wood pellet market could not be seen as a market in equilibrium. Due to a number of circumstances, the market was facing a shortage on the supply side. This was caused by a higher demand from European households, who were replacing their expensive fossil fuels with wood pellets; higher demand from power companies and various congestions in the supply of pellets due to a long period of cold weather. All this lead to circumstances in which suppliers did not manage to meet the demand. Some emergent market areas were trying to solve the lack of supply but that turned out to be futile when it appeared that some of the new producing parties tended not to honour contracts but sold their shipments to more than one party at the same time. This is one of example which shows that not all wood pellet producing areas are making progress in the steps towards a mature market.

Unstable markets such as the pellet market make it difficult to sign long-term, large-volume contracts as this is seen as too risky. Also, with no harmonised support policy (e.g. on an EU level), new national incentives (and associated demand for bio energy) may distort the market and shift supply to other countries within a short timeframe (Faber et al., 2006). Due to increasing international competition, Dutch traders expect a further growing demand for cheap biomass streams in the mid-term (5-10 years) in developed countries, but also in developing countries due to an expected rise in local demand (Junginger and Faaij, 2005).

Due to the small volumes, biomass trade is so far basically 100% bilateral, i.e. direct agreements between buyer and seller. A few biomass exchange websites have emerged over the past year, but traded volumes remain low so far.

4.2 Technical barriers

A general problem with specific biomass is its variety in physical and chemical properties such as low density e.g. high ash and moisture content, nitrogen, sulphur or chlorine content, making it difficult and expensive to transport; and often unsuitable for directly use, say for co-firing with coal or natural gas power plants. Power producers are generally reluctant to experiment with new biomass streams, e.g. bagasse or rice husks. As these streams often do not have the required physical and chemical properties, power producers are afraid to damage their installations (designed for fossil fuels), especially the boilers. While technology is available to deal with the fuels (e.g. different types of fluidized bed boilers), it may take several years or even decades before the old capacity is replaced. On the longer term, the limited ability to use different fuels may lead to a restricted availability of biomass fuels (Junginger and Faaij, 2005).

4.3 Logistical barriers

One of the problems of logistical barriers is a general lack of technically mature pre-treatment technologies in compacting biomass at low cost to facilitate transportation, although this fortunately improving. Densification technology has improved significantly recently e.g. for pellets although this technology is only suitable for certain biomass types. Also, the final density per cubic meter is still far less than e.g. oil given the nature of biomass. Pyrolysis or torrefaction may be a possible pre-treatment option, but still needs to be proven on a commercial scale. In the case of the import of liquid biofuels (e.g. ethanol, vegetable oils, biodiesel), this is not an issue, as the energy density of these biofuels is relatively high.

When setting up biomass fuel supply chains, for large-scale biomass systems, logistics are a pivotal part in the system. Various studies have shown that long-distance international transport by ship is feasible in terms of energy use and transportation *costs* (e.g. Hamelinck, 2004) but availability of suitable vessels and meteorological conditions (e.g. winter time in Scandinavia and Russia) need be considered.

However, local transportation by truck (both in biomass exporting and importing countries) may be a high cost factor, which can influence the overall energy balance and total biomass costs (see e.g. Batidzirai et al., 2006; Hamelinck, 2004). For example, in Brazil, new sugarcane plantations are considered in the Centre-West, but the cost of transport and lack of infrastructure can be a serious constraint. Harbour and terminal suitability to handle large biomass streams can also hinder the import and export of biomass to certain regions. The most favourable situation is when the end user has the facility close to the harbour avoiding additional transport by trucks.

The lack of significant volumes of biomass can also hamper logistics. In order to achieve low costs, large volumes need to be shipped on a more regular basis. Only if this can be assured, there will be forthcoming investment on the supply side (e.g. new biomass pellet factories) at this will reduce costs significantly. The bulky nature of biomass fuels and the relatively low value per unit would restrict availability of suitable areas for handling of these fuels in busy ports. On the other hand, this bulky nature in combination with high demand for specific biomass streams has caused that the present capacity (incl. storage, handling equipment, etc.) of some harbours (e.g. Stockholm, Gothenburg, Immingham, several harbours in the Baltic states) is fully utilized. A further increase in biomass handling would require specific investment.

4.4 International trade barriers

As with other traded goods, several forms of biomass can face technical trade barriers. As some biomass streams have only recently been started traded, so far no technical specifications for biomass (see above) and no specific biomass import regulations exist. This can be a major hindrance to trading. For example, in the EU most residues that contain traces of starches are considered potential animal fodder, and thus subject to EU import levies. For example, rice residues containing 0-35% starch are levied 44 €/ton (about 3.1 €/GJ) (Junginger and Faaij, 2005). For

denaturised ethanol of 80% and above, the import levy is 102 €/m^3 (about 4.9 €/GJ), representing substantial additional costs. For example, Brazil is planning to increase ethanol production drastically over the next 8 years, and to start up biodiesel production from soy beans, palm oil, etc. Only a fraction will be exported, the rest will be used domestically. However, Brazil could in theory export more ethanol than is far scheduled. The major constraint is that countries with the main demand – US, Japan and the EU – are completely or partially closed due to trade barriers. The United States applies ad valorem duties of 2.5% for imports from most-favoured-nation (MFN) countries and 20% for imports from other countries. Japan applies ad valorem duties of 27% (MFN treatment). At present, these duties represent a significant barrier to trade, influencing the competitiveness of foreign imports. It is important to ensure that treatment takes into consideration the status of the exporting countries to account for their level of development and potential for export. Finally, it is important to bear in mind that some technical trade barriers can be, in fact, imposed to constraint imports and to protect local producers.

Another issue connected with international trade are transport tariffs. In recent years, general transport tariffs have increased quite significantly e.g. wood pellets to the Netherlands were on average 1.75 €/GJ (on a total cost of 7-7.5€) in 2004 (van Sambeek et al., 2004).

In addition, the risk of contamination of imported biomass with pathogens or pests (e.g. insects, fungi) is another important limiting factor in international trade. For example, untreated round wood and chips from outside Europe are banned for import into the EU. Similarly, agricultural residues which could be used both as fodder and biomass, may currently be denied entry if it does not meet certain fodder requirements. However, it is important to bear in mind that these limitations are not exclusive to bio energy.

A potential future trade barrier may be the biotechnology issue. Many countries (mainly in EU) are highly opposed to import products where biotechnology was used (Cartagena Protocol on Biosafety). However, in the case of short rotation plantations and the energy crops, genetic modifications i.e. for the increasing the yield or the water content are beneficial to bring down production costs.

4.5 Ecological barriers

Large-scale biomass dedicated energy plantations may in principal pose various ecological and environmental issues that cannot be ignored, e.g. monocultures and associated (potential) loss of biodiversity, soil erosion, fresh water use, nutrient leaching and pollution from chemicals (Lewandowski and Faaij, 2004; Smeets et al, 2004). For example, the cultivation of soy beans in Brazil and palm oil in Indonesia and Malaysia (and the possible use of the vegetable oils as feedstock for biofuels) have been strongly criticized by various environmental NGOs because of the negative social and environmental effects. However, studies have shown that for dedicated energy crop plantations in general these problems can be less serious when compared with plantations for food or fodder production. If designed and managed wisely, biomass plantations can be multi-functional and generate local environmental benefits. For example, willow plantations in Sweden may be used for soil carbon accumulation, increased soil fertility, reduced nutrient leaching, shelter belts for the prevention of soil erosion, plantations for the removal of cadmium from contaminated arable land (phytoextraction), and vegetation filters for the treatment of nutrient-rich, polluted water (Berndes, G. and Börjesson, P., 2006). Short rotation woody crops (SRC) in general require very few inputs of herbicides and pesticides. Rich et al. (2001) suggest SRC plantations are generally better for a wide variety of wildlife than existing adjacent farmland around the ARBRE project area (UK). When established on agricultural land it usually results in an increase in bio-diversity, e.g. no significant displacement of species and in some cases an actual increase of species. SRC is generally regarded as environmentally friendly and most environmental groups view the technology favourably. Also, in the UK large scale SRC monoculture is unlikely given the nature of land tenure. Rather, the most likely scenario may be large number of small plots scattered over large areas.

4.6 Social barriers

Also linked to the potential large scale energy plantations are the social implications, e.g. the effect on the quality of employment (which may increase, or decrease, depending on the level on mechanization, local conditions, etc.), potential use of child labour, education and access to health

care (Lewandowski and Faaij, 2004; Douglas et al., 2004). However, such implications will reflect prevailing situations and would not, necessarily, be better or worse than any other similar activity. One example is the agricultural sector in Brazil, where social securities and child labour are still important issues, which have however significantly improved over the period of 1992-2004. An account of the positive contributions of the sugarcane and ethanol industry on job creation and income is given by Macedo et al. (2005, see chapter 12). Further examples of social benefits are highlighted by e.g. Woods and Hall (1994) for developing countries and Perlack et al. (1995) on woody biomass plantations.

4.7 Competition between biomass for energy applications and for other end uses

Various types of biomass can be utilized for different end-uses other than energy, e.g. as raw material for the pulp and paper industry, as raw material for the (chemical) industry (e.g. tall oil or ethanol), as animal fodder (e.g. straw) or for humans consumption (e.g. ethanol or palm oil). This competition can be directly for biomass, but is also often focussed on land availability.

Food versus fuel is a very old issue that is frequently brought up despite the fact that a large number of studies have demonstrated that land availability is not the real problem (Partners 4 Africa, 2005). While theoretically large areas of (abandoned/degraded) crop land are available for biomass cultivation, biomass production costs are generally higher due to lower yields and accessibility difficulties. Deforested areas may be easier as they may have more productive soil, but is generally considered unsustainable in the long term. Food security, i.e. production and access to food, would not probably be affected by large energy plantations if proper management and policies are put in place. However, in practice food availability is not the problem, but the lack of purchasing power of the poorer strata of the population.

As mentioned above, next to competition with food, there also may be competition with other applications, such as fodder. If there was a large increase in demand for energy, say of agricultural residues, scarcity of fodder products may occur, leading to price increases. Furthermore, in the Netherlands, the fodder industry sees the feed-in tariff for electricity from biomass as an indirect subsidy for agro-residues (Junginger and Faaij, 2005). On the other hand, also the use of fodder is subsidized. Similar arguments have been voiced by the Scandinavian pulp and paper industry, which fear a shortage (and thus rise of prices) of wood chips and unfair competition if wood chips are subsidized and extensively utilized for production of renewable electricity.

4.8 Methodological barriers – lack of clear international accounting rules

Before large-scale international trade of bio energy can be implemented, clear rules and standards need to be established e.g. who is entitled to the CO_2 credits. Another related issue concerns to the methodology that shall be used to evaluate the avoided emissions, considering the fuel life cycle. As these avoided emissions typically depend strongly on the chosen reference system, it is debatable whether the same methodology should be applied to all biomass sources.

Another issue is the indirect import of biomass for energy (processed biomass). Biomass trade can be considered as a direct trade of fuels and as indirect flows of raw materials that end up as fuels in energy production after the production process of the main product. For example, in Finland, the biggest international biomass trade volume is indirect trade of raw wood (including round wood and pulp chips). Almost half of these imports end up as by-products (e.g. bark, sawdust and black liquor) which are used for energy production.

4.9 Legal (national) barriers

Biomass for energy may be limited by international environmental laws. For example, in the Netherlands, four out of five major biomass power producers consider obtaining emission permits as one of the major obstacles for further deployment of various biomass streams for electricity production. The main problem is that Dutch emission standards are not entirely consistent with EU emission standards. In several cases in 2003 and 2004, permits given by local authorities have been declared invalid by Dutch courts (Junginger and Faaij, 2005).

4.10 Lack of information dissemination

Both the benefits of sustainable biomass energy in general and specifically the need for international biomass trade are still largely unknown to many stakeholders such as industrial parties, policy makers, NGOs and the general public. More active dissemination of information by the IEA Bioenergy programme, various UN institutions, national governments and other organizations is required.

5. Broader issues to be considered in relation to biomass trade

5.1 Energy balances and local use vs. international trade

The overall energy balance of biomass and biofuels use needs to be positive, although this is not always clear cut. Energy balances have improved considerably in the past or so decade as productivity has increased with lower inputs e.g. as in the case of ethanol from sugar cane in Brazil (Macedo, 2005). Similarly, some oil crops like palm oil, dende and macaúba can deliver biodiesel with relatively high energy output/input ratios (Horta Nogueira, 2005). Compared to this, the current production of ethanol from wheat and sugar beet or biodiesel from rape seed (as is currently the main practice within the EU) only display mediocre energy balances (Quirin et al, 2004). Development of such first-generation biofuels with mediocre energy balances on a large scale are often driven by other considerations such as fuel security, and employment in the agricultural sector, and could be considered unsustainable on the longer term. Import of e.g. ethanol from sugar cane would in general show better energy balances. On the other hand energy balances are somewhat worsened by long-distance transport (especially when including substantial transportation by truck).

Connected to this issue is the question whether biofuels should be used preferably locally or traded internationally. While many developing countries have a low energy consumption compared to developed countries, their energy demand is increasing rapidly. Should biomass for energy be utilized locally or for export; should market forces have the last say? For example, Finland currently exports large volumes of pellets to other EU countries, which could also be utilized domestically. The main drivers are higher incentives paid for (electricity from) pellets in other European countries. It can be expected that countries which have great difficulties in meeting commitments (Kyoto, green policies, etc.) will introduce stronger incentives. From an energy efficiency point of view, in general, it would be more rational to use the biomass primarily locally, and only the (certificated) excess should be exported. However, the actual energy balances and CO_2 emission reductions also depend strongly on the reference energy systems in both the exporting and importing country. Furthermore, it should be borne in mind that international competition will force domestic producers to be more competitive.

6. Possible approaches and recommendations

6.1 Solving sustainability issues: International classification and certification of biomass

Certification of biomass may be one way to prevent negative environmental and social side-effects. By setting up minimum social and ecological standards, and tracing biomass from production to end- use, the sustainability of biomass can be ensured. In an exploratory study has been shown that such social and environmental standards do not necessarily result in high additional costs (Smeets et al, 2005).

However, when implementing a certification scheme for sustainable bio energy, several other issues have to be dealt with. First, criteria and indicators need to be designed and adopted according to the requirements of a biomass producing region. Also, the compliance with the criteria has to be controllable in practice, without incurring high additional costs. It is crucial that this is ensured, otherwise, those who are able to cheat the system are winners." An example of problematic certification is the logging situation in some countries. Typically, in order to prevent illegal cuttings, regional organizations and local organisations can hand out permits. In practice, these organisations are paid money under the table to obtain the logging permits, which poses the

question whether illegal cutting or bribing officials is worse. Too strict certification without decent controls can lead to dangerous situations.

Secondly, avoidance of leakage effects (leakage can be defined as activity-induced changes in land use that occur outside the area in which the activity takes place)[5]. The net effect is that carbon benefits gained in one place are partially lost in (leak away) in another location. Leakage in the context of biomass trade could stand for an unwanted shift of activities from the area of biomass production to another area where it leads to negative effects on the environment (Lewandowksi and Faaij, 2004). Summarizing, in order to succeed, the certification process cannot be expensive, cannot be slow and bureaucratic and cannot add additional – and indirect – barriers.

There are several ways forward from the current situation:

1. The initiative for sustainable biomass certification can be left to the market stakeholders. Examples are the Green Gold Label developed by Essent. These initiatives are developed by market stakeholders, but they are not binding. Thus, they are unlikely to include criteria that involve (substantial) additional costs.
2. National governments can develop sustainability requirements (e.g. in order to be eligible for subsidies) systems. This is currently being done by Belgium for the production of renewable electricity from biomass. Similarly, legislation is under preparation in the United Kingdom for biofuels, and in the Netherlands for renewable electricity from biomass. These national criteria could be initially based on minimum sustainability demands, but raised over time (e.g. to include avoidance of leakage effects, increased demands on GHG balances etc.). However, a multitude of different commercial or national certification systems with different sustainability criteria would likely create additional barriers for biomass trade. Therefore, a joint declaration of general, basic principles would be useful.
3. Develop an international certification standard for sustainable biomass. This should be done by a consortium of all stakeholder groups producing, trading and utilizing biomass, and would allow for a uniform standard. While this would probably take several years to develop, it would offer the possibility for harmonizing minimum sustainability standards. Such an international system could also include a methodology on how to allocate the CO_2 reduction benefits.

To achieve both growing markets and long-term sustainable biomass trade, a pragmatic approach is needed. It is recommended to focus first on routes with low barriers regarding its sustainability (e.g. wood pellets from already certified forestry), and to identify the routes that allow larger benefits, considering all aspects that are used to identify sustainable biofuel production. A compromise should be found between developing certification efforts and ensuring sustainability of bio energy and developing the market. While not all biomass types may fulfil the entire set of sustainability criteria initially, the emphasis should be on the continuous improvement of sustainability. For such an approach, public information dissemination and support is crucial. Furthermore, it is interesting to note that so far only importing countries are known to prepare sustainability criteria for biomass, while also exporting countries should define what in their view constitutes a sustainable biomass supply. **It is recommended for both for importing and exporting countries to pursue a combination of the approaches mentioned above: short-term develop set minimum sustainability criteria, and long-term development of an international standard.**

6.2 Setting up technical biomass standards and recording international statistics (volumes and prices) on bio energy trade

In order for biomass to become a large-scale commodity, that can be traded on a exchange (e.g. a pellet exchange), technical standards are needed. **It is recommended to set up internationally accepted quality standards for specific biomass streams (e.g. CEN biofuel standards).** Biomass end users may also have a higher confidence in using different biomass streams if they meet such quality standards. Task 40 may possibly contribute on this, e.g. by collecting information on technical specifications required by consumers and convey them to potential suppliers.

[5] An example for a leakage effect is the shift of logging activities to Myanmar and Cambodia after the ban on logging forests in Thailand, instituted in 1989 (Lewandowski and Faaij, 2004).

Furthermore, classification of organic matter streams as specific biomass fuel may aid WTO classification as environmental goods and services (EGS).

Furthermore, as mentioned above, there are two main problems with biomass trade statistics: either, no international statistics are kept at all (e.g. wood pellets), or there are statistics available on the flows, but the end use is unknown. For example, there are statistics for ethanol or palm oil, but it is unclear how much is used for energy purposes, and how much for or other purposes (e.g. as food, fodder or chemical feedstock etc.)

Task 40 recommends to the IEA, UNCTAD and national trade organisation to include (new) biomass types in their statistics, and to include the final application (e.g. energy, chemical feedstock, fodder etc.) where possible.

Also, in order to create more market transparency, both industry stakeholders and policy makers are advised to encourage the establishment of exchanges for biomass products.

6.3 Lowering of trade barriers

On the topic of technical trade barriers, Coelho (2005) suggests that biofuels could help industrialized countries to promote reduction of carbon emissions but, in some cases – as is the case of ethanol exporting to US and EU – exporting countries face trade barriers. Most of these barriers are established based on technical reasons, but often the intention is also to protect local producers that have production costs much higher than developing countries. The solution pointed by some analysts is to liberalize environmental goods and services – EGS – and to include biofuels as EGS. The Doha Round negotiations on the liberalisation of environmental goods and services with a view of phasing out tariffs could provide some opportunities for expanded national markets. However, so far there is no consensus whether biofuels should be included as environmental goods (Melendez-Ortiz et al., 2005). **Task 40 recommends that on the longer-term import barriers for biomass and biofuels should be lowered or abolished over time (e.g. import taxes for bioethanol) to enable a further development of international biotrade. At the same time, Task 40 recognises the need for sustainability criteria for biomass to prevent the unchecked and unsustainable production of biomass.**

6.4 Long-term harmonization of support policies, creating a stable demand-side

Short-term policy incentives to stimulate the use of biomass are crucial and should be kept to provide investment security. Also, national support systems are often specifically in place to compensate for specific local characteristics. However, varying policy incentives can also disturb market mechanisms, as was recently shown for biomass trade between Germany and the Netherlands (Faber et al., 2006).**Therefore, on the longer-term, harmonization of market support policies in the EU is deemed desirable to stimulate international trade**. This would require a gradual process of adjusting the various European support systems. It is not necessarily a requirement to use a uniform support system throughout the EU, the different systems could be better adjusted to each other to avoid large-scale market distortions and waste of subsidies.

Connected to this, the issue of uncertain governmental support policies should be addressed. Within the European Union, not a single country has set binding biomass or biofuel targets beyond 2010. **In order to create long-term incentives to invest in biomass markets, countries with biomass targets (or renewable energy targets in general) are advised to formulate sound long-term biomass policies, including new targets with a time horizon of at least 10 years or longer, e.g. 2020, in order to create clarity and security for the industry for long-term investments.**

6.5 Creating a sustainable supply side

During the beginning of 2006, demand for biomass has been rising rapidly, and has caused strong price increases in e.g. pellets. This is increasing the risks of unsustainable exploitation of biomass resources. Therefore, next to (mandatory) biomass sustainability certification, it is important to stimulate a sustainable increase in the supply-side. Investments are required in several areas. First of all, the agricultural and forestry residues currently being produced are often inaccessible due to

logistical obstacles (both prohibitive costs and high energy requirements for transportation). Improved infrastructure and pretreatment technologies (such as mobile forest slash bundlers or pyrolysis units) could make a larger potential of unused residues accessible. **Further technology development in this direction should be stimulated**. Second, **projects by e.g. the World Bank or FAO should recognize and increasingly stimulate the use of residues as important (by-) products and actively promote energy crops as bio energy source**. Finally, as residue potentials are limited, increasingly investments in energy crops for production of solid and liquid biofuels will be come necessary. If unchecked, there is no guarantee that these additional energy crops will be produced sustainable, **reemphasizing the need for sustainability criteria**.

6.6 Stimulate both economic efficiency and energy efficiency

In general, free markets should be able to ensure economic efficiency. To ensure additional efficiency from an energy point of view, **policy incentives could include requirements for energy and/or CO_2 balances**. For example, in Wallonia, Belgium, the government requires an energy balance for all biomass (domestic and imported) used for renewable electricity generation. Subsidies for renewable electricity certificates (paid per MWh) are adjusted according to the amount of CO_2 already used during production and transportation of biomass (Ministère de la region Wallonne, 2002). Thus, there is an economic incentive to use biomass streams with low amounts of CO_2 emissions in the supply chain.

In addition, sustainability from an economic point of view means production with no subsidies on the long term. So, subsidies to foster local production, or subsidies for biomass chains with unfavourable energy balances, are unacceptable policies.

7. Summary and conclusions

The main targets of biotrade are to provide a stable and reliable demand for sustainable production of biofuels in rural communities, to provide a source of additional income and an increase in employment and to contribute to the sustainable management of natural resources for exporting countries. For importing countries, biotrade may enable them to fulfil cost-effectively GHG emission reduction targets, diversify their fuel mix and lead to a more sustainable energy production.

A multitude of different barriers currently exist, hampering the development of international biotrade. These include economic, technical, logistical, ecological, social, cognitive, legal, and trade barriers, lack of clear international accounting rules and statistics, and issues regarding land availability, deforestation, energy balances, potential conflicts with food production and local use vs. international trade.

To address these barriers, a number of recommendations are made:

To ensure *biomass sustainability*, it is recommended for both for importing and exporting countries to pursue short-term development of a minimum set of sustainability criteria, and long-term development of an international sustainability standard for biomass.

For *market transparency*, Task 40 recommends to the IEA, UNCTAD and national trade organisation to include (new) biomass types in their statistics, and to include the final application (e.g. energy, chemical feedstock, fodder etc.) where possible.

To *stimulate international trade*, Task 40 recommends that on the longer-term import barriers for biomass and biofuels should be lowered or abolished (e.g. import taxes for bioethanol) over time to enable a further development of international biotrade. At the same time, Task 40 recognises the need for sustainability criteria for biomass to prevent the unchecked and unsustainable production of biomass.

To create a *stable demand-side*,

- on the longer-term, harmonization of market support policies is deemed desirable to stimulate international trade
- Policy incentives could also include requirements for energy and/or CO_2 balances.

- In order to create long-term incentives to invest in biomass markets, countries with biomass targets (or renewable energy targets in general) are advised to formulate sound long-term biomass policies, including new targets with a time horizon of at least 10 years or longer, e.g. 2020, in order to create clarity and security for the industry for long-term investments.

To stimulate a *stable supply side*

- Improved logistical infrastructure on the supply-side is needed
- Further technology development of pretreatment technologies should be stimulated
- Projects by e.g. the World Bank or FAO should recognize and increasingly stimulate the use of residues as important (by-) products and actively promote energy crops as bio energy source.

Appendix III. Samenvatting efforts certificering (internationale review)

J. van Dam, M. Junginger, A. Faaij, I. Juergens, G. Best; Overview of recent developments in sustainable biomass certification Paper written within the frame of IEA Bioenergy Task 40, December 2006.

[While the authors are all member of IEA Bioenergy Task 40, the issues, positions, and strategies described are not necessarily those of the IEA Bioenergy agreement].

1. Introduction

Increases in the price of fossil fuels, growing environmental concerns regarding their use and impacts (including climate change) and considerations regarding the security and diversification of energy supply have increased the use of renewable energy sources such as biomass worldwide. Expectations for the coming years, based on energy scenarios and various policy objectives, indicate a growing increase in the global production of biomass on a global scale and for many nations.

The global production of liquid biofuels is now estimated to be over 35 billion litres (EC 2006). Ethanol currently accounts for more than 90% of total biofuel production. Global fuel ethanol production more than doubled between 2000 and 2005, while production of biodiesel, starting from a much smaller base, expanded nearly fourfold (WWI 2006). Some examples: Brazil has exported in 2004 2.5 billion litres of ethanol (same in 2005) with main destinations India (23.1%) and USA (20.2%) (Walter *et al.* 2006). The rapidly changing character of worldwide biofuel production capabilities is also illustrated by recent trends in the United States. In 1995, U.S. biodiesel production was 1.9 million litres; by 2005 this was more than 280 million litres (WWI 2006).

Beside the strong increase in liquid biofuels, trade and production in pellet and solid biomass production is also rising. Total Canadian exports of wood pellets was around 625,000 tonnes in 2006 (Swaan 2006). In the Netherlands, imports for electricity production have increased by a factor of seven from 2003 to 2005, and nowadays about 80% of all electricity produced from biomass is imported. For 2004, Essent, the largest user of biomass in the Netherlands, reported that approximately 30% of the biomass originated from North America, 25% from Western Europe and 20% from Asia, with the remainder from Africa, Eastern Europe, Russia and South America (Junginger *et al.* 2006).

The growing use and production of biomass as a renewable energy source has created an international biomass market and leads to increasing trade in biomass resources. International trade in biofuels and related feedstock may provide win-win opportunities to all countries: for several importing countries it is a necessary precondition for meeting self-imposed targets. For exporting countries, especially small and medium developing countries, export markets are necessary to initiate their industries (Zarrilli 2006).

The production of biomass energy crops and the removal of biomass residues from forest and agricultural systems for energy production can result in negative ecological impacts, changing land-use patterns, socio-economic impacts and GHG emissions (e.g. for transport and vs. alternative use on-site)[6]. With considerable increase in feedstock and biofuels expected, sustainable production is becoming a key concern and is currently being considered as a possible requirement for market access, e.g. in the first draft of the EU biofuels directive (Zarrilli 2006, EC 2006). Setting standards and establishing certification schemes are possible strategies that can help ensure that biofuels are produced in a sustainable manner (WWI 2006).

Recently, these aspects have been recognized by policy makers, scientists and others and since then various efforts have been undertaken as steps towards certification and track-and-trace systems for imported biomass. The objective of this paper is to give an overview of recent developments in sustainable biomass certification from different viewpoints of stakeholders up until

[6] Note that also the end use of biomass can cause negative environmental effects, e.g. the combustion of contaminated waste wood. However, for the end-use in many countries already (strict) environmental regulations ensure the sustainable end-use of biomass.

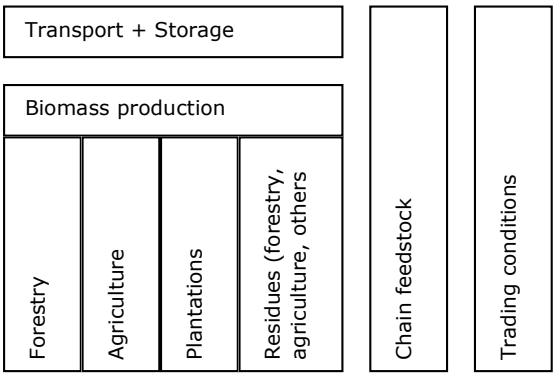
the end of 2006. A second objective is to identify synergy and risks in the development of biomass certification and to give, based on this, some final recommendations and conclusions.

This report starts in section 2 with an overview of existing certification systems, which can be used as a basis for a biomass certification system. The study includes an inventory of initiatives in the field of biomass certification from the perspective of various stakeholder groups (NGOs, companies, national government and international bodies and networks), which is described in section 3. Section 4 focuses on possible strategies and implications for the implementation of a biomass certification system, indicated by the various stakeholder groups. In section 5, the paper concludes with an overall discussion of the developments and possibilities to move forward.

2. Overview of preceding frameworks as basis for biomass certification

Precedents in the field of sustainability certification exist for a wide range of products. Relevant for the development of a biomass certification system are certification systems for forestry and agricultural products and electricity. The basic principles and processes for international certification systems can be found in annex 1.

Figure 1: Existing areas demanding criteria and indicator development for sustainable biomass trade



The introduction of forest certification was led by the Forest Stewardship Council (FSC) and a range of other schemes became operational at the end of the last decade (Zarrilli 2006). FSC accredited certification bodies carry out **FSC certification**. Two types of FSC certificates are available from certification bodies: the Forest Management (FM) Certificate and the Chain of custody certificate. Chain-of-custody is the path taken by raw materials from the forest to the consumer, including all successive stages of processing, transformation, manufacturing and distribution. FSC is constantly reviewing its processes and criteria. At this moment the FSC Principles and Criteria in plantations (to further improve e.g. inclusion of social issues and issues on conversion of other land uses) and on pesticides are under review (FSC AC 2003).

Another large forest certification system is the **Pan-European Forestry Certificate** (PEFC). PEFC is a global umbrella organisation for the assessment and mutual recognition of national forest certification schemes. PEFC has in its membership 32 independent national forest certification systems. Of these 22 schemes, in total accounting for over 191 million hectares of certified forests, have been through a rigorous assessment process (PEFC 2006). An example of a national forest certification scheme is the FFCS (Finnish Forestry Certification System). The commercially exploited Scandinavian forests are certified to a very large extent, e.g. over 95% in Finland (FFCS 2006). To our knowledge, there are no systems to certify biomass from these forests (e.g. wood chips or pellets).

For the agricultural sector, different certification systems (e.g. **EUREPGAP**[7], **SAN**[8]) are developed to ensure that products are produced in an environmental sustainable way and are safer or

[7] The main aim of EUREPGAP certification is to ensure good quality of the certified fruits and vegetables. The rules concentrate on quality management, minimization of negative environmental impacts of crop production and track-and-trace control, see also www.eurep.org.

[8] SAN stands for Sustainable Agriculture Network, which is a coalition of independent conservation groups that promote the social and environmental sustainability of production in several key commodity areas .

healthier for the consumer. Certification systems for fair traded agricultural products (e.g. FAIRTRADE) have also been implemented to ensure 'fair' payments of agricultural products, enhance producers' quality of life and improve their market access (Zarrilli 2006).

For the energy sector, a number of **green electricity labels (EUGENE, Milieukeur, ok-power, Green Power, Austrian Ecolabel** etc.) exist and some of them include a definition for biomass. In general, two approaches in defining green electricity from biomass can be found: (1) definition of the allowed feeding material in the first place and additional criteria defining the ecological quality of the biomass and exclusion of certain technologies or types of biomass and (2) specification of the technology (plant types) and assessment of the individual plant, which applies for certification, criteria regarding the feeding material are additionally applied. Annex 6 gives additional information about the criteria applied by different green electricity labels (Oehme 2006).

Related to the certification systems as mentioned above, is the existence of **different indicator and criteria systems** to guarantee sustainability, e.g. ILO[9] has developed a set of criteria for sustainable labour conditions. Criteria of existing certification schemes and indicator systems addressing sound resource management and responsible enterprise behaviour are being considered, and partly used in the development of biomass certification systems.

3. Key actors in the development of biomass certification

The last years, different stakeholder groups have recognized the need for biomass sustainability criteria and various groups are working on the development of a biomass certification system or on principles and criteria to describe sustainable biomass trade. Stakeholder groups have different interest in biomass certification (Lewandowski *et al.* 2005). In this paper, developments in biomass certification from the viewpoint of four stakeholder groups are described: national governments, companies, non-governmental organizations (NGOs) and international organizations and initiatives.

Table 1: Stakeholder groups and interests in certification, partly based on Lewandowski *et al.* (2005):

Stakeholders	Some interests for biomass certification
National governments	Policy instrument to promote sustainable management and sustainable consumption pattern, provides information for policy consultancy
Transnational Organisations	EU – the most powerful player for establishing international standards, at least within its area of power (i.e. its member countries)
Intergovernmental Organizations	The UN and FAO in particular play an important (potential) role as a neutral forum for negotiations between all kinds of stakeholders (particularly countries).
Companies (producers, trade, industry)	Instrument for environmental marketing and market access, tool for controlling origin and quality of raw materials, products or services, provides information for optimization of production processes, allows for product differentiation
NGOs	Provides information on the impacts of products, provides information whether the product meets quality or technical standards, instrument to promote sustainable management
International bodies and initiatives	Instrument to promote sustainable management and sustainable consumption pattern, information for policy consultancy and collaboration

3.1 Inventory of viewpoints of national governments

Many national governments in the world are promoting the use of biomass and the production of biofuels and renewable energy in their countries (see annex 14). Few of them have taken initiatives to work on the development of a biomass certification system or on principles and criteria to describe sustainable biomass trade. As far as known, these countries are Belgium, the Netherlands, United Kingdom and Brazil and Canada to some extent. On supra national level, the European Commission is also prominently active in the development of biomass certification.

Belgium has ambitious targets for green electricity production, and is currently importing wood pellets for power production (about 700 kton in 2005). Since sustainability energy is a regional

[9] ILO is an abbreviation for International Labour Organization

competence in Belgium, certificate systems have been implemented in three regions (Brussels, Flanders, and Wallonia) for Renewable Energy Sources (RES) as well as for Combined Heat and Power (CHP). The different regions have chosen to apply different certificate systems (Verhaegen *et al.* 2005). The system in Flanders in based upon the energy balance and the use of fossil energy along the supply chain that is then subtracted 'pro rata' from the granted certificate per MWhe of green electricity. The system in Wallonia is compatible with the one in the Brussels region. It is based upon avoided fossil CO_2 emissions according to a LCA with respect to the reference of the combined cycle power plant firing natural gas with an efficiency of (as it is now) 55% (Marchal *et al.* 2006). For certification of imported biomass, Walloon authority imposes that each supplier undergoes an audit within six months. This audit must examine the sustainability of the wood sourcing as well as detail the energy balance (through an energy audit including GHG emissions) of the whole supply chain. The sustainability of the wood sourcing can be delivered according to (1) forest certificates, e.g. FSC, (2) a traceable chain management system at the suppliers end or, in the absence of such certification, (3) all public documents originating from independent bodies making a review of forest management or control in the considered country. For each producer, the global supply chain is analyzed by SGS international, accepted as independent body by all Belgian authorities for the grant of green certificates. If the product would appear in contradiction with the sustainability principle, the CwaPE (energy regulator in Wallonia) has the right to cancel the granted green certificates. Until now, Flanders authorities have not yet requested audits or a certification procedure for imported biomass by law (Marchal *et al.* 2006).

Over the last years, **The Netherlands** has been importing wood pellets, agricultural residues and bio-oil for electricity production (Junginger *et al.* 2006). The Dutch government has expressed its intention to incorporate sustainability criteria for biomass in relevant policy instruments. In the short term this could include the Environmental Quality Electricity Production (MEP) and the obligation for biofuels for road transport. In the longer term a broader application of these sustainability criteria is envisaged. A project group "Sustainable Production of Biomass" was established in January 2006 by the Interdepartmental Programme Management Energy Transition to develop a system for biomass sustainability criteria for the Netherlands for the production and conversion of biomass for energy, fuels and chemistry.

A set of generic sustainability criteria and corresponding sustainability indicators is formulated. They have followed the triple P approach (people, planet, profit) and aimed at keeping in line, as much as possible, with already existing conventions and certification systems. In the elaboration no distinction has been made between imported biomass and biomass that is produced in the Netherlands. However, the criteria only apply for biomass that is applied in the Netherlands, not for possible transit. Key starting points of the project group were (Cramer *et al.* 2006):

- Development of a long-term vision about biomass sustainability (2020-2040) and, based on this vision, development of concrete, measure biomass sustainability criteria on the short term;
- Development of a universal framework of sustainability criteria, with the emphasis on non-food applications (chemical industry, fuels, energy production);
- The sustainability criteria and indicators developed could also be of importance to judge food production on sustainability aspects. It is acknowledged that biomass, feed, fuel and fodder can barely be regarded separately;
- Compliance with international treaties, EU regulations, WTO rules etc;
- Development of minimum sustainability demands for short term, and stricter criteria on the longer term;
- Sustainability criteria are valid for both biomass energy crops and biomass crops, and both applicable for imported biomass and domestic biomass.

Based on this and consultations with Dutch stakeholders and scientific support, the project group developed a number of biomass sustainability criteria and indicators/procedures for the short-term (2007) and the medium term (2011). See also table 2.

Table 2: Summary of sustainability criteria, indicators, procedures and suggested levels for 2007 and 2011 (Cramer *et al.* 2006):

Criterion and level	Indicator/procedure 2007	2011
1. GHG balance, net emission reduction by >=30% in 2007 and >= 50% in 2011	Testing with the aid of calculation methods, Use of standard values for different steps in standard chains	As 2007
2. Competition with food, local energy supply, medicines and building materials Insight in the availability of biomass for above in 2007, Supply is not allowed to decrease in 2011	Footnote [10]	Footnote [11]
3. Biodiversity, no deterioration of protected areas or valuable ecosystems; in 2011 also insight into active protection of local eco-systems	No plantations near gazetted protected areas or High Conservation Value areas maximum 5% conversion of forest to plantations within 5 years, Footnote 4	Footnote 5. As 2007 Additional obligatory management plan for active protection of local ecosystems
4. Economic prosperity, insight into possible negative effects on the regional and national economy in 2007, insight into active contribution to the increase of prosperity in 2011	Footnote 4, based on Economic Performance indicators as expressed in the Global Reporting Initiative	Footnote 5
5. Well-being, including		
5.a Working conditions of workers No tightening in 2011	Compliance with Social Accountability 8000 and other treaties	As 2007
5.b Human rights No tightening in 2011	Compliance with universal declaration of Human Rights	As 2007
5.c Property rights and rights of use No tightening in 2011	Three criteria from existing systems (RSPO 2.3, FSC 2, FSC 3)	As 2007
5.d *Insight in social conditions of local population* In 2011, insight into active contribution to improvement of social circumstances local population	Footnote 4	Footnote 5
5.e *Integrity* No tightening in 2011	Compliance with Business principles of countering bribery	As 2007
6. Environment, No negative effects on the environment including:		
6.a Waste management No tightening in 2011	Compliance with local & national legislation and regulation, GAP principles	As 2007
6.b use of agro-chemicals (incl. Fertilizers)	Compliance with local & national legislation and regulation	Comply with strictest EU, local, national rules and legislation
6.c Insight into the prevention of erosion and soil exhaustion, and conservation of the fertility level	Footnote 4. Reporting includes following aspects: Erosion management plan; Prevention of extensive cultivation on steep slopes, marginal or vulnerable soil; Monitoring of the condition of the soil and management plan; Nutrient balance	Footnote 5

[10] For this criterion a reporting obligation applies. A protocol for reporting will be developed.
[11] New performance indicators will be developed for this criterion between 2007-2011.

Criterion and level	Indicator/procedure 2007	2011
6.d Insight into conservation of quality and quantity of surface and groundwater	Footnote 4, special attention for water use and treatment	Footnote 5
6.e Emissions to air	Comply with local and national legislation and regulations	Comply with EU regulations

For criteria 2-6 a dialog with national and local stakeholders is required.

A pilot study has been initiated by Control Union Certifications within the framework of the project group. The study evaluated the possibilities of implementing the sustainability criteria in the field. The study also looked at the compatibility of the sustainability criteria to the Green Gold Label (see 3.2.1), the RSPO standard (see 3.4.2) and the 'Utz Kapeh Code of Conduct' 2006[12]. Findings show that the principles are, to varying degree, already included in existing standards. The sustainability criteria from (Cramer *et al.* 2006) require greater attention to carbon dioxide emissions, competition (principle 2) and certain environmental matters. The verifiers are, however, achievable and only some of the verifiers required for the GHG balance were difficult to achieve (Control-Union 2006).

The government of the **United Kingdom** announced in November 2005 the introduction of a new policy to ensure the inclusion of biofuels and, potentially in the future, other renewable fuels in UK transport fuels. The 'Renewable Transport Fuel Obligation' (RTFO) is the UK's primary mechanism to deliver the objectives of the Biofuels Directive and will place a legal requirement on transport fuel suppliers to ensure that a specified percentage of their overall fuel sales are from a renewable source. A feasibility study indicates that the RTFO could be introduced at the earliest in April 2008. Next to the RTFO, the UK is developing an assurance scheme to ensure, as far as possible, that biofuels are produced from a sustainable source (Department for Transport 2006).

A feasibility study, commissioned by the UK government, has recommended linking RTFO certificates with GHG savings determined though a standardized GHG certification system (Bauen *et al.* 2005). The recommended methods for GHG certification involves developing accepted industry standards for fuel carbon intensity, where the fuel's carbon intensity is calculated from a combination of verified process data, provided by the fuel producer/supplier, and of default values, developed by an independent methodology unit. Initially, the scope of the assurance scheme concentrates on GHG certification, with a clear understanding that, as the assurance scheme develops, incorporation of other sustainability measures would be addressed. At this stage of development, the study (from 2005) recommends that other environmental and social criteria should be covered by a separate voluntary scheme, developed by industry stakeholders, but not directly linked to the RTFO (Bauen *et al.* 2005).

Brazil has since 1975 a government program to make ethanol from sugarcane. In 2002, a more or less similar program was launched for biodiesel. Starting in 2008, a 2% addition of biodiesel to petrol diesel will become mandatory (Zarrilli 2006). In Brazil no certification systems for biomass and biofuels are currently in use. However, initial activities to include sustainability criteria into biomass production are taking place. The Social Fuel seal, for example, is part of the biodiesel program. The label[13] establishes the conditions for industrial producers of biodiesel to obtain tax benefits and credit. In order to receive the seal, an industrial producer must purchase feedstock from family farmers and enter into a legally binding agreement with them to establish specific income levels and guarantee technical assistance and training (Governo Federal 2006).

For sugarcane production, environmental licensing includes e.g. control on land use and soil impacts. In the State of Sao Paulo (produces 60% of all sugarcane) a schedule was established to gradually reduce the burning of sugarcane[14] over the next twenty years. In 2000, additional steps were taken to eliminate burning and shift practices over to mechanized harvesting. Controversial

[12] This is an internationally recognized set of economic, social and environmental criteria for responsible coffee production

[13] Label, Selo Combstível Social, awarded by the Ministry of Agrarian Development, www.biodiesel.gov.br

[14] One of the harmful environmental effects from sugarcane production is the burning of fields to facilitate manual harvesting. This produces GHG, ash and other airborne particulates.

outcomes of these policies are the immediate unemployment of over 100,000 of the nation's 1.2 million seasonal sugarcane workers and the creation of incentives for producers to relocate their farms to avoid regulation (Martines-Filhao *et al.* 2006). For other agricultural products, the EUREGAP system is applied to some extent and part of the forestry plantations are FSC certified.

Canada is a major producer and exporter of wood pellets produces and also produces ethanol from grain. Canada is planning to increase the ethanol production substantially over the next years. The Environmental Choice^{M} Program (ECP) is a national program in Canada sponsored by Environment Canada, to recognize manufacturers and suppliers that produce products and services, which are environmentally preferable or less harmful to the environment. Companies that meet the criteria are certified as EcoLogo^{M} companies and can use the certification to market to environmentally conscious consumers. The label, belonging to the Canadian Government, is an environmental certification mark for a wide range of products. The ECP has criteria in place for the renewable green power sector (water, solar, biomass, etc) in the North American region (incl. USA) (NRC 2005). The EcoLogo^{M} has a general set of criteria for renewable energy sources, accompanied by specific criteria for biomass and biogas. Criteria for biomass are (ECP 2006) see also annex 9:

- Use only wood wastes, agricultural wastes and/or dedicated energy crops;
- Requirements for rates of harvest and environmental management systems/practices;
- Maximum levels for emissions of air pollutants.

Up until now, the focus of **Germany** has been to enable and support domestic production, being one of the main biodiesel producers in Europe. However, more ambitious targets, such as an 8% share of all transport fuels from biomass by 2020, cannot be reached without considering some imports (WWI 2006). A draft Biofuel Quota Act was recently submitted mapping out admixture quotas for biofuels by promoting legally defined mixture quotas, which will increase over time. This draft national regulation includes a provision, which empowers the German government to establish sustainability requirements for biofuels that are eligible to participate in the quota system. The German Parliament recently called on the government to make use of this provision and to draft such an ordinance for minimum sustainability standards by mid 2007 (Fritsche, U. *et al.* 2006b). Beside, the German Technical Cooperation (GTZ) has carried out studies on the potential and implications on agriculture and sustainability by liquid biofuels for transport for various developing countries as India (Kashyap *et al.* 2005) and China (Gehua *et al.* 2006). The study includes and analysis of the sustainability of biofuel development relating environmental, social and economic criteria to the Indian context.

On supra-national level, the **European Commission (EC)** is active in the development of biomass certification. The Biomass Action Plan (EC 2006) mentions that, in the context of the review of the Biofuels Directive[15] to be carried out by the end of 2006, the assessment and monitoring of the full environmental impact of biofuels will receive attention. One of the issues in this review report will be the requirement that, through a system of certificates, only biofuels whose cultivation complies with minimum sustainability standards will count towards the targets. The EC will also consider how this could be applied for biomass used for other energy purposes. The system of certificates would need to apply in a non-discriminatory way to domestically produced biofuels and imports (EC 2005). Some practical issues that need to be further looked at are (Hodson 2006):

- What are the characteristics of biofuel production the EU wants to discourage / encourage?
- How to measure these characteristics?
- How should the procedural / institutional structure to set incentives for biofuels look like?
- How to ensure compliance for this mechanism?

Mid 2006, the EC has launched an invitation to tender for a study on sustainability criteria and certification systems for biomass production that have been developed and/or proposed by various organizations at European and international level (E.U. Center 2006). It is likely that the Commission will propose, based on the review report, an amended Biofuels directive early 2007. If a new draft is proposed, some form of certification system is likely to be included (Prins 2007).

Biofuels and their raw materials are traded on world markets. An additional Communication from the EU (EC 2006) focuses more on trade issues and the role of developing countries. The report recommends a regulated market approach and favours a balanced approach in trade negotiations

[15] Directive 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (OJ L 123, 17.5.2003)

concerning biofuels, in its approach to balance domestic production and/or imports (EC 2006). The EU must respect the interests of domestic producers and EU trading partners, within the context of rising demand for biofuels (EC 2005). The EU recognizes that the production of biofuels from suitable feedstock could generate economic and environmental benefits in a number of developing countries, create additional employment, reduce energy import bills and open up potential export markets. The EU will support developing countries that wish to produce biofuels and develop their domestic markets[16] and its EU development policy aims to help suitable developing countries capture the benefits offered by biofuels, while addressing these concerns in an appropriate way (EC 2006). The Commission will take these objectives forward in bilateral negotiations and multilateral negotiations (e.g. the Doha World Trade Organization round and discussion on trade in environmental goods) (EC 2005).
Thus, a trend can be seen that national governments worldwide are developing new biomass policies. Most of these policies relate to targets or incentives to stimulate the use of renewable energy sources in their country. A few national governments (Netherlands, UK, Belgium) and EU on supra-national level have taken the initiative to start developing a policy framework for biomass certification. For these national (EU) governments, regulation of biomass standards has to respect existing WTO rules and EU regulation. Policy instruments (in development) to promote sustainable biomass are e.g. legislation and incentives (subsidies) when producers have complied with the sustainability criteria.

The systems in Belgium and UK have as main criteria the reduction of GHG emissions for sustainable biomass certification. For UK this is possibly later extended to other criteria. Reasons for UK to focus at this stage only on GHG emissions as criteria are possible WTO implications and feasibility of implementation. Only the Netherlands has developed a set of principles including environmental, social and economic criteria. A framework for implementation is, however, still in process. The EC intends to develop a system of certificates so that only biofuels whose cultivation complies with minimum sustainability standards will count towards the targets and is considering how to apply these minimum standards could also for biomass used for other energy purposes.

3.2 Inventory of the viewpoints of companies

Nowadays, different support systems (e.g. feed-in tariffs and certificates) have been initiated and implemented to accomplish national targets on the use of renewable energy sources (RES) and biofuels. Recent developments in the field of biomass certification show that this has stimulated companies, involved in the supply, finance or use of electricity from biomass or biofuels, to initiate initiatives in this field.

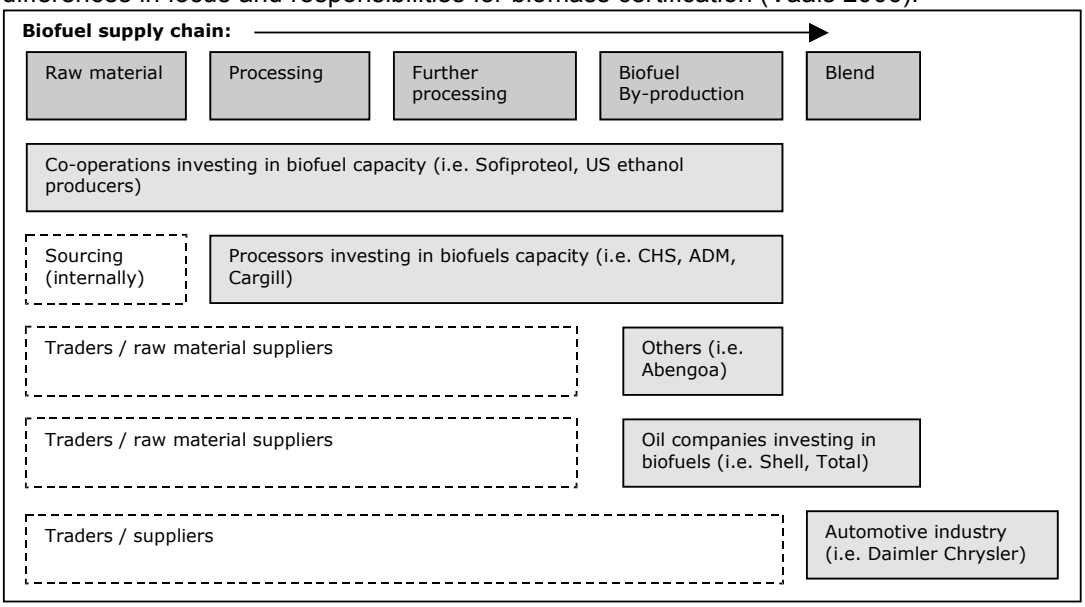
3.2.1 Parties in the biofuel / biomass supply chain

National initiatives and legislation (see 3.1) have triggered initiatives on biomass certification at companies active in the biofuel and biomass supply chain. For biomass, the supply and processing chain leads to a chain interaction of various parties, depending on the economic segments in which they are active (see also figure 2). Companies focus their initiatives on the part of the chain in which they are active and responsible. A number of companies who recently included the sustainable production of biofuels are listed below[17].

[16] The EU's preferential import of bioethanol in the EU basically comes under two regimes: the Generalised System of Preferences (GSP) and the Cotonou Agreement. The preferential agreements and import conditions are defined during negotiations. Beneficiaries include a number of – mainly developing – countries

[17] Given the current rapid development of new initiatives, this list of examples should not be considered exhaustive.

Figure 2: Companies active in different economic segments of the biofuel supply chain, resulting in differences in focus and responsibilities for biomass certification (Vaals 2006):



Various companies, trading and supplying raw materials that can be used as biomass feedstock are involved in the discussion of biomass certification. E.g. **CARGILL B.V.** (*trader / raw material supplier)* is a member of the RSPO (see section 3.4). The company produces, trades and refines a variety of agricultural products and food ingredients including palm oil. The company owns and oil palm plantation in Indonesia and two refineries in Malaysia (CARGILL 2006). The company is in the Netherlands a member of the project group 'Sustainable Production of Biomass', as well as the company **CEFETRA** (*trader / raw material supplier).* CEFETRA trades a number of compounds feed raw materials and plays a coordinating and organizational role in several supply chains. CEFETRA indicates it is important for them to secure its (independent) sourcing and get as close as possible to the primary production / producer to get direct influence on various factors as e.g. quality, track & tracing, non-GMO and sustainability. An integrated pricing system with a shortened supply system will increase the steering power of CEFETRA on these issues (Stam 2006).

UNILEVER has acquired expertise in dealing with the vegetable oil market (*processing and supply*). It has undertaken several sustainability initiatives in partnership with other stakeholders and is chair of the RSPO. Unilever supports initiatives to improve energy efficiency and the use of renewable energy and has expressed its concerns about current biofuel policies (Mortished 2006), further explained in a 'Biofuels Unilever Position Statement'(Unilever 2006). Concerns relate to, among others, a decrease in availability of raw materials and sustainability aspects due to increased pressure on land and environmental, cost and energy yield aspects of low-performance biofuels. Unilever believes that the EC and governments have the responsibility to subject their proposed policies to a full sustainability impact assessment covering both foreign and domestic dimensions including criteria as energy yield, cost effectiveness, public health, sustainability of bio-fuel production, market based development and all effected industries" (Unilever 2006).

SHELL (*oil company*) is one of the larger blenders of transport biofuels. Shell is also interested in biomass upstream to secure its biofuels business although it has limited experience with biomass as feedstock. Foundation Shell Research and Probos Foundation have invited a group of experts to take place in the 'Biomass Upstream Steering Group' (BUS) in 2004. BUS enables Shell to identify opportunities and threats of biomass use, learn about sustainability and acceptability and make the right choices. BUS supported several studies related to the sustainability of biomass[18] (Voss 2004).

In 2005, **DaimlerChrysler** (*automobile company*) signed the Magdeburg Declaration with UNEP in which they state to promote sustainable mobility by supporting activities and further tap the potentials of biofuels. This was agreed upon in a Memorandum of Understanding in February 2006.

[18] See also http://www.biomassa-upstream.nl/

The two organizations call on producers for biofuels to take environmental and sustainability aspects into account in their cultivation processes and intend to support the development of a 'sustainability seal' (similar to what FSC provides for wood products) for the cultivation of biomass for biofuels. Other activities of the partnership include conducting engine tests, promoting a Jatropha project in India, organizing the biennial Magdeburg Environmental Forum (platform for experts) and the development of second-generation biofuels (DaimlerChrysler 2006). See also 3.4.1.

The fuel concept of **Volkswagen** (*automobile company)* is based on second-generation biofuels which can be produced from biomass, are to a large extent CO_2 neutral and do not compete with food production. Volkswagen considers the present assessment regarding the sustainability of 1st and 2nd generation biofuels as unsatisfactory, both in economic and environmental terms, commenting that '1st generation biofuels receive tax incentives from scarce budget resources and consequently constitute a bad investment'. Volkswagen is therefore calling on politicians to develop a sustainable tax model providing a secure network for investing in the development and market launch of new fuels. Apart from taking CO_2 efficiency as criteria, also other sustainability criteria as social standards, security of supply or protection of rainforests, should be included in fuel taxation. Volkswagen has developed a tax model catering for both CO_2 efficiency (primary criteria) and a set of additional sustainability criteria (Volkswagen 2006).

BioX is a company for liquid biomass from palm oil, imported from Malaysia. The company is an RSPO member and has its own Code of Conduct and position paper of palm oil for energy generation. BioX, together with Control Union is in the process of evaluating the RSPO-criteria for auditing and certification purposes. BioX developed a questionnaire and pre-auditing document to audit palm oil production locations on the RSPO-criteria and will audit palm oil producers to verify if they comply with the RSPO sustainability principles and criteria. An issue that not has been covered by the RSPO-criteria is the CO_2-neutrality of the palm oil biomass. BioX has started a study to determine the CO_2-emissions that are related to the growing, production and transportation of palm oil. Since May 2006, BioX is joining the GGL program (see 3.2.2) (BioX 2006).

Financing companies, as **Rabobank International,** play an active role in the discussion of sustainable biomass production. Rabobank is a member of the Dutch project group 'Sustainable production of Biomass' and RSPO member. Some recommendations with respect to sustainable bio-energy are given in (Fresco *et al.* 2006), e.g. indicating that bio-energy projects should be judged on a case by case basis taking into account ecological, social and economic criteria. More general recommendations are the need for Public Private Partnerships to innovate the rural sector through bio-energy and the development of a policy integrating bio-energy farming, food and feed farming, which can potentially solve both local food shortages and increase income of poor people.

3.2.2 Companies in the electricity supply chain

Demand on using RES is stimulated by obliging end-users to produce a share of their electricity (imposed by a quota obligation) by RES. For practical reasons, this obligation is usually not imposed on the consumer but on electricity suppliers or distribution companies. This has introduced market mechanisms and trade in sustainable energy production. Besides, it requests for the development of a certificate system for the available RES, including biomass, to guarantee its sustainability (Verhaegen *et al.* 2005). This stimulated electricity suppliers in Europe, using biomass as feedstock, to start initiatives to develop their own biomass certification systems.

The Electrabel label is a certification procedure for imported biomass and developed by Electrabel, a European energy company. For Electrabel, it is necessary to inform a potential supplier of all requirements made by Electrabel concerning the sustainability criteria for being accepted within the Belgian green certificate systems (see 3.1) and the technical specifications of the product for firing it in a thermal power plant (Marchal *et al.* 2006). Electrabel has decided to apply the same certification procedure in the different Belgian regions, gathering the auditing requirements for the import of biomass of Flanders and Wallonia.

In order for biomass to be accepted according to Electrabel's standards, it must be the (by-) product from agriculture and forestry and related company branches. Biomass (solid recovered fuels) must consist of organic material coming from well-managed woods, (public) zones of vegetation or

agricultural grounds. Energy consumption must be reasonable with respect to other references. Heat for drying must be generated from renewable sources (biomass) (Electrabel 2006). The requirements are concentrated in one single document called “Supplier Declaration”. This document is signed by a representative of the producer and is verified and stamped by a certified inspection body before being delivered to the Belgian authority. The Inspection Company SGS is in charge of checking the document and carrying out a full audit of the plant and of the supply chain within the 6 months following the first time the biomass is fired (Marchal *et al.* 2006). An example how and where in the supply chain independent verifications take place is shown in annex 7 for wood pellets.

For calculating the number of granted certificates Flemish authorities require the knowledge of a list of parameters related to the plant. Therefore, the supplier must fill in an informative questionnaire that consists of three functional parts (Electrabel 2006). These are: 1) sourcing and management: origin of biomass, 2) production chain, including energy consumptions and 3) transport and storage, including rail and sea transport. The questionnaire is dedicated to the suppliers of the biomass products and includes both mandatory questions as well as informative (non-mandatory) questions. The questionnaire for part 1 is included as example in annex 7 (Electrabel 2006).
The largest Dutch user of biomass, **Essent** (also RPSO member), has developed the biomass certification system **Green Gold Label** (GGL) in cooperation with Peterson Bulk Logistics and Control Union Certifications. This development started in 2002. It aims at a track and trace system for biomass from (by-) products from the power plant (and its green power it produces) back to the sustainable source. In this system mixing or contamination with non-intrinsic or environmentally harmful materials is prohibited. In every link of the chain written proof must be available that the GGL quality system is supported, sustained and maintained. The system consists of six different standards covering the complete biomass chain from production till end-use including the bio-energy plant (see annex 8 for example for standard 1 on chain of custody and processing) (GGL 2005). The standards define amongst others chain-of-custody standards, criteria for forest management (internationally recognized forest management standards) and criteria for agricultural products (Control Union 2006).

The GGL accepts existing certification systems (e.g. FSC and CSA standards), but has additional guidelines for pellets manufacturing and transportation. A major criterion within GGL is the requirement for tracking custody of the biomass. GGL is continuously improving its certification system and is currently looking at possibilities to include social criteria in its certification system (Maris 2006). Beside Electrabel and Essent, also various **other energy companies in Europe** (Fortum in Nordic countries, Eneco in the Netherlands, others) are currently considering or developing a biomass certification system (Maris 2006).

Thus, companies are actively involved in various parts of the biomass chain. Their interest in biomass certification is dependent on the role they play in the production, transport and processing of biomass, e.g. energy companies have to justify the sustainability of their end product to the costumer. This has promoted companies as Essent and Electrabel to develop a biomass certification system. Currently, other energy companies are also, on an individual basis, active in developing (separate) biomass certification systems (Maris 2006). Companies as DaimlerChrysler, Volkswagen or Shell, active on the end side of the biomass chain, are involved in research and pilot projects related to new technologies and sustainability of their end products. Companies on the production and transporting side of biomass play a role in how to guarantee sustainable biomass production. For companies as Unilever or Cargill, trading products for food and/or energy production, a discussion on food security and change of economics for their products is also highly relevant.

3.3 Inventory of the viewpoints of NGOs

Several NGOs have expressed their viewpoints on sustainable bio-energy production and started initiatives on biomass certification. In general, NGOs indicate to be positive about the possible opportunities offered by sustainable bio-energy production but also mention their concerns on potential environmental and socio-economic harm due to increased bio-energy production. For example, Birdlife International “could not support further development of the Bioenergy crops industry without an appropriate certification scheme in place and introduced along other promotion measures…’ (Birdlife-International 2005). In the so-called ‘Bonn Declaration’ from 2004 several **civil organizations from Latin America and the Caribbean** express their viewpoints on renewable energy in general. They stress the need, among other things, of energy access to civilians in the

region with minimal local, national and global environmental impacts. Financial incentives should be redirected to sustainable renewable energy sources as biomass, excluding projects with negative social and environmental impacts (Several 2004). **WWF Brazil**, playing an active role in the discussion of certification of biofuels in Latin America, stresses the need for a certification system in Brazil to ensure they are produced in an environmentally and socially friendly way (Volpi 2006). These viewpoints are written down in various position papers and reports.

Position papers, including sustainability principles or key concerns for sustainable biomass are developed by, as far as known, the following NGOs:

- **NGOs in South Africa**[19] (Sugrue *et al.* 2006), see also annex 10
- **FBOMS**[20] **in Brazil** (Moret *et al.* 2006), see also annex 11
- **WWF Germany** (Fritsche, U. *et al.* 2006b) see annex 4 (coincide with criteria WWF International)
- **NGOs in the Netherlands**[21] (Verweij *et al.* 2006), (Richert *et al.* 2006), see annex 3
- **IATP in the USA** developed sustainability principles for bioindustrial crop production, see annex 15, (Kleinschmidt 2006)
- **Greenpeace** and **Birdlife International** (to limited extent)

Table 3 provides an overview of these sustainability criteria showing that, although there is a consensus on the need to develop criteria, there is variation among them. For example, FBOMS has included 'gender equality' as a separate criterion while this criterion is not or hardly mentioned in other lists. Also, there is a difference in priority (e.g. between environmental and socio-economic criteria), strictness (e.g. use of GMOs, GHG balance) and level of detail given to these criteria. It is aimed to make this list in table 3 as conclusive as possible. However, NGO activities to promote sustainable biomass production develop fast and more principles may be developed or under way. A compiled list of concerns and issues indicated by organizations is also developed by (Bramble 2006), aiming to bring those pieces together into a coherent international governance structure for sustainable biomass production and use.

Various NGOs have started pilot projects and case studies to learn more about the use of sustainability criteria and the impact of sustainable biomass production in developing countries. A group of Dutch NGOs (Lange *et al.* 2006) has initiated three case studies with product/country combinations in developing countries (**Brazil, South Africa, Indonesia**) to gather information on risks and opportunities from export of biomass flows, analysed by a Sustainability Assessment Framework (see annex 12). The report has also gathered opinions from stakeholders in these countries to include their viewpoints in the debate in the Netherlands. The report reflects a comparison between results derived from this project and criteria proposed by the Dutch project group on sustainability criteria (section 3.1) and provides recommendations for a further dialogue.

The NGO **Solidaridad** has initiated the fair trade label Utz Kapeh. Solidaridad is focusing in its program 'renewable energy' on biomass for export from developing countries and is implementing, together with the energy company Essent, a pilot biomass certification project for coffee husks from Brazil. The coffee husks originate from coffee plantations, certified by Utz Kapeh. An external monitoring of the pilot takes place according to the sustainability principles from (Cramer *et al.* 2006). For Solidaridad, this project is interesting as it stimulates farmers to produce sustainable products (conform GGL from Essent). Also, the project contributes to a reduction of the greenhouse effect, offers producers in developing countries extra income and, for producers in the food chain, biomass is a step towards a (complimentary) participation of the energy chain (Solidaridad 2006).

German NGO representatives from the environment and development sector (Maier *et al.* 2005), **WWF** (Fritsche, U.R. *et al.* 2006a), (WWF 2006b) and others also provide recommendations specifically related to approaches for the implementation of a certification system for sustainable biomass. These recommendations are further discussed in section 5.

[19] Developed by South African CURES network www.cures-network.org
[20] FBOMS: Energy working group of the Brazilian Forum of NGOs and Social Movements for Environment and Development
[21] NGOs include: Milieudefensie, BothEnds, WWF, Greenpeace, Natuur en Milieu, Oxfam Novib

Thus, various NGOs are actively involved in the development of a biomass certification system. Initiatives are taken to develop proposals on principles and criteria for sustainable biomass certification, including environmental, social and economic criteria. NGOs are mainly active on the production side of the biomass chain and have a strong concern about the environment and well being of the poor in rural areas. Some NGOs have provided suggestions on the implementation for a biomass certification system. NGOs play an active role in forums and have started pilot studies.

Table 3: Summary of sustainability principles from various NGOs as mentioned in reports and position papers:

	South Africa	Dutch NGOs	IATP	Greenpeace	Birdlife	WWF Germany	FBOMS
GHG, energy balance	Full LCA, Energy balance crop > 1:3		Energy η and conservation		Include LCA carbon savings	Defined levels of GHG outputs and η (LCA)	Diversification of energy mix
Competition food, energy	No extension productive land, energy to the poor by own production	No violation of right to food security, concern for – indirect- land competition				Priority for food supply and food security, include regional impacts	Food security, no monocultures, crop diversity
Economic prosperity	Economic stimulus to rural communities, access to (rural) energy for poor	Promote (local) socio-economic development, no economic burden on vulnerable groups	Economic sustainability			Ensuring a share of proceeds	Rural credits, job income and generation, diversification, decentralization of activities
Working conditions		Labour conditions, human health impacts	Safe and healthy conditions			Health impacts, worker rights, share of proceeds	Organization of production, labour relations
Human rights		No violation, right of children				No violation	Gender equality
Property rights and rights of use	Indigenous land ownership, land redistribution	Equitable land ownership, land-tenure conflicts to be avoided				Rights to land use clearly defined	
Social conditions		Revenues invested in social well-being	Respect social, cultural heritage				Social inclusion Participation in decision making
Integrity							Social accountability
Environment	*See for details below*	*Revenues invested in environment*		*See for details below*	*Environment al impacts general*	*See for details below*	*See for details below*
Origin of biomass	Crop types, no annual crops						Crop diversity, no monocultures
Biodiversity	Maintained	Maintained, production energy crops increases ecological quality, risk conversion land use	Promote biological diversity, nature	Concern: burning wood from ancient forests	Include criteria on biodiversity	No additional negative biodiversity impacts, no negative land use changes	Defined limits for occupation of biomes; comply with economic, ecological zoning;
Waste	EIA on potential waste						

	South Africa	Dutch NGOs	IATP	Greenpeace	Birdlife	WWF Germany	FBOMS
Use of agro-chemicals			Sound nutrient management	No / limit use of fertilizer, pesticide		Avoiding negative impacts	Minimization or elimination of pesticide use;
Farming practices	Conservation farming techniques, intercropping	Associated farming practices to protect environment				Production practices	Use of best available practices; diversity of crops;
Soil quality	Maintained	Sustainable use of soil resources	Strengthening the soil	Concern: loss of topsoil		No additional soil erosion and degradation	Reduction of soil loss
Water quality and quantity	No extension irrigated land, measures	Sustainable use of water resources	Protecting water	Concern: risk for increase in salinity		Protection of water bodies	
Emissions to air	EIA to determine potential pollution		Protecting air	Concern: toxic emissions			
No GMOs	Prohibited	Currently not allowed	Prohibit GMO	No Use of GMOs		Exclusion GMO	No priority
Training	Included						Training, technology transfer
Institutional, governance	Included	Good governance, government context included, land use planning	Stakeholder participation, transparency			Land use planning, EIA of biomass production	Regulatory compliance, region classified by EIA

3.4 Inventory from viewpoints of international bodies, organizations and initiatives

On an international level, activities to develop a biomass certification system are initiated by international bodies and organizations (3.4.1). International networks and roundtables in which various stakeholders (NGOs, IGOs, companies, government) participate also promote initiatives (3.4.2)

3.4.1 International bodies and initiatives

Different international bodies have recognized the need for biomass sustainability criteria. Within the UN, **UN-Energy,** created in 2004 as a follow-up to the World Summit on Sustainable Development (WSSD) in Johannesburg, is the principal interagency mechanism in the field of energy. Its purpose is to help ensure coherence in the UN system's response to the WSSD and to collectively engage non-UN stakeholders. An overview of activities from UN-Energy and its members (e.g. World Bank, various UN organizations, FAO) can be found in (UN-Energy 2006). Next to this, the **UN Biofuels Initiative** (UNBI) is established to promote sustainable production and use of biofuels in developing countries, under conditions that can attract foreign and domestic investment. UNBI will assess biofuels potentials within developing countries and work with national decision-makers and private-sector groups, including NGOs and civil society groups, to develop country-specific strategies (National Biofuels Action Programs) for the production and use of biofuels. The initiative is coordinated by UNCTAD and operates with participation of FAO, UNDP, UNEP and UNIDO (UNF 2006).

As UNBI is more focused on trade, the **International Bioenergy Platform IBEP** (established by the FAO) is more focused on knowledge management and transfer. IBEP provides expertise and advice for governments and private operators to formulate bio energy policies and strategies. It also assists developing tools to quantify bio energy resources and implications for sustainable development in general and food security in particular, on a country-by-country basis. IBEP has developed a proposed plan of action. One of the activities mentioned is to assist in the development of an international scheme to develop workable assurances and certification bases principles, methodologies, criteria and verifiable indicators (FAO 2006). One of the activities planned by IBEP and starting in December 2006 is the development of an analytical framework to assess the implications of different types of bio energy systems on for a set of different food security contexts., resulting in the formulation of national strategies, based on recommendations on how to undertake bio energy development.

FAO has, besides IBEP, also initiatives on biomass certification within its **FAO Forestry Department**. This department is working, in cooperation with **IEA Task 31**[22], on the evaluation of principles, criteria and indicators for both biomass from forest used for energy as well as for wood fuel and charcoal production systems. Starting point in this study was to review existing forest certification schemes (e.g. FSC). Based on this proposal, criteria are developed to cover forest biomass for energy. These will be tested in the field using case studies. Case studies in Chile, Brazil, Tanzania, Madagascar, Senegal & the Philippines are planned to start end 2006, with the others running a bit later. For the production systems (including the transport from the forest site), the key factors influencing the production chain are assessed as well as an evaluation of the impact of the various steps of that chain in ecological, social and economic terms. The project is also analyzing the legal and institutional framework into/under which wood fuel production systems fall. Using the results of the assessment a set of criteria covering ecological and socio-economic aspects of the production cycle will be developed and eventually be tested in the field (Rose 2006).

UNEP has started the Certification of Biomass Project, which is an outcome on the 4th Environmental Forum in Magdeburg and is started in cooperation with DaimlerChrysler (see also section 3.2). One of the main activities in this partnership is aimed at developing sustainability criteria for the cultivation of biomass used for bio fuels production. A core-working group (also with UNEP, WWF, others) was formed to pursue this initiative on investigating criteria and indicators for ensuring sustainability pathways for biomass production. For this initiative, preparatory activities (as in September 2006) include (Ernest 2006, personal communication):

[22] IEA Tasks are heading under the bioenergy agreement of the International Energy Agency. Task 31: Conventional forestry systems for sustainable production of biomass

- Review of existing certification systems linked to biomass certification;
- Compilation of certification labels (forestry, bio energy and palm oil, agricultural and trade labels)
- Compilation of ongoing initiatives by the international communities and country policies on biofuels. Aim is to work in complimentary with different organizations on similar activities that will enhance the output and gain greater acceptance of the end product
- An assessment of crop for biofuels: Understanding the different requirement of crops including geographical mapping.

Bioenergy has the biggest number of registered projects (32.5%) in the pipeline for the Clean Development Mechanism, administered by the **United Nations Framework Convention on Climate Change** (UNFCCC) having as one of its objectives, the development of monitoring and baseline methodologies for CDM projects. Up till now only a few methodologies for biofuels are approved because of uncertainties in determining 'leakage' (Fritsche, U. *et al.* 2006b). To date no CDM projects related to liquid biofuels have been approved, likely because of overall lack of capacity in CDM project development in many developing countries, and limited availability of CDM baseline methodology specifically developed for biofuels projects (UNCTAD 2006).

Another international initiative is the **IEA Bioenergy Task 40**[16] (www.bioenergtrade.org) on International Sustainable Bioenergy Trade. The aim of the task is to investigate what is needed to create a commodity market for bio energy. Interested parties as industry, NGOs, governmental bodies as well as FAO and World Bank participate in this task. Key priorities of the task are certification, standardization and terminology for sustainable biomass trade (A. Faaij 2006). A workshop was organized in 2005 in Brazil, in cooperation with IEA Bio-energy tasks 30 and 31, on sustainable biomass production for the world market. Key recommendations from the workshop related to biomass certification were:
- The aim should be an internationally accepted framework based on existing experiences;
- A great diversity of competing systems should be avoided. A certification system could be created by initiating a gradual process for certification procedures, starting at regional level;
- The certification system should include a wide variety of stakeholders to ensure credibility.
- It could be based on current best practices and supported with high quality scientific knowledge.
- A gradual development is needed, and such a certification system should not create new barriers, i.e. as gained with the CDM should be avoided.
- Crucial in a system is the build-up of credibility by verification and accreditation of the data.

Studies from IEA Task 40 members on biomass certification are related to the development of a certification system for sustainable bio-energy trade in general (Lewandowski *et al.* 2005) and case studies on the impacts of sustainability criteria on the costs and potentials of bio energy production in Brazil and Ukraine (Smeets *et al.* 2005).

The **G8 Global Bioenergy Partnership, (GBEP),** was launched in May 2006 and has to provide a framework for the G8 countries to ensure a better coordination of ongoing activities on the issue of bio energy, as well as a more efficient use of the financial and technical resources involved (ETAP 2006). A White Paper has indicated barriers for bio energy development, areas for action and possible roles for the Global Bioenergy Partnership in these identified areas (Clini *et al.* 2005). The Secretariat of GBEP is hosted at FAO.

3.4.2. International networks and roundtables

EUGENE is an independent network of environmental and consumer organizations and research institutes. EUGENE promotes green electricity labelling as a market-tool to facilitate and stimulate additional production of renewable and energy efficient services. The label of EUGENE is applicable to geothermal, wind, solar, electric, hydropower and biomass energy and is given to defined 'eligible sources'. Eligible sources for biomass are, e.g., dedicated energy crops, residual straw from agriculture etc. EUGENE does not provide more specific criteria for eligible biomass resources, like e.g. production methods (Lewandowski *et al.* 2005). EUGENE has developed a study as support for possible certification of biomass, which includes a proposal of biomass criteria for application by EUGENE standard. The criteria are subdivided in two groups (Oehme 2006) as shown in Table 4.

Table 4: Summary of proposal biomass criteria for application by EUGENE (Oehme 2006):

Criteria, which can easily become operational and monitored / verified:
Eligibility of sources (including e.g. woody, herbaceous and fruit biomass)
Requirements on the origin of wood fuel (sustainable forest management, certification for plantations)
Use of Genetically Modified Organisms (GMO) is not permitted
Energy crops and SRC crops shall not be produced on converted land
Emissions of CH_4, N_2O and NH_3 by usage of manure have to be reduced
In the annual average, the plant need to met an overall efficiency of at least 60%
Co-firing of solid biomass is permitted under conditions (e.g. required efficiency of 70%)
Criteria for which further elaboration is needed to become operational:
Wood fuel from non-certified forest has to meet a set of criteria (e.g. should not come from illegal harvesting or from High Conservation Value Forest)
Maintenance of soil fertility
Biomass from dedicated cultivation on arable land needs to comply with guidelines for integrated crop protection, livestock waste should comply with principles of integrated farming
The non-renewable proportion of the energy that is used for extraction, transportation and processing, and also balancing, is not permitted to be greater than 10% of the electricity supplied with the label.

Issues surrounding the production of large commodities as palm oil, soybeans or sugarcane (which can all be used as feedstock for biofuels), in Southeast Asia and South America have triggered initiatives as the establishment of round tables where all stakeholders in the chain are represented. The **Roundtable on Sustainable Palm Oil** (RSPO) is an association created by organizations carrying out their activities in and around the entire supply chain for palm oil. RSPO has developed a set of 8 principles and 48 criteria for sustainable palm oil production, which were adopted in November 2005 (RSPO 2005). The principles relate to social, economic, ecological and general criteria. The RSPO criteria are now in a 2-year trial phase. Third party verification arrangements are needed for evaluation of compliance with the RSPO principles and criteria, and in supply chain audits to verify compliance with requirements for sustainable palm oil traceability. The RSPO Verification Working Group (VWG) is established and has published some preliminary recommendations on verification arrangements (RSPO 2006).

Table 5: RSPO principles to promote sustainable oil palm production (RSPO 2005)

Principles RSPO
Commitment to transparency
Compliance with applicable laws and regulations
Commitment to long-term economic and financial viability
Use of appropriate best practices by growers and millers
Environmental responsibility and conservation of natural resources and biodiversity
Responsible consideration of employees and of individuals and communities affected by growers and mills
Responsible development of new plantings
Commitment to continuous improvement in key areas of activity

The First Global **Roundtable on Sustainable Soy** was held in March 2005. The RTRS has as one of its objectives to develop and promote criteria for the production of soy on an economically viable, socially equitable and environmentally sustainable basis. The program of the 2nd Conference of the RTRS in September 2006 includes several presentations showing examples of responsible production models and an overview of certification options (RTRS 2006). The developed 'Basel Criteria for responsible Soy production[23]' forms a relevant background document in the light of these developments, see also (ProForest 2004). A similar initiative has started for sugarcane by the establishment of the **Better Sugarcane Initiative** (BSI)[24]. This multi-stakeholder collaboration has as one of its aims the determination of principles and the definition of globally applicable

[23] The purpose of the Basel Criteria for Responsible Soy Production was to provide a working definition of acceptable soy production that can be used by individual retailers or producers. The criteria were developed by Proforest (also involved in RSPO) for COOP Switzerland in cooperation with WWF Switzerland.

[24] A similar initiative for sustainable sugarcane production can be found on www.sucre-ethique.org

performance-based standards for ‘better sugarcane’ with respect to its environmental and social impacts (WWF 2006a).

Thus, initiatives initiated by international bodies focus on a wide range of activities as coherence, support to developing countries and exchange and transfer of information. Some of these international bodies have formulated specific projects, often in collaboration with partners, to get more insight in the development of a biomass certification system. International networks and roundtables are based on a voluntary basis. They have started, supported by their own members, activities for the development of a certification system for their own target product.

Summarizing the initiatives from all stakeholder groups, table 6 provides an overview of the involvement of the stakeholder groups in the discussion of biomass certification system. Table 7 shows that various biomass certification systems exist or are under development to guarantee the eligibility of the biomass source and its transport or to guarantee the sustainability of its production (woody biomass, palm oil or soy). These systems show some coherence but differ in the inclusion of the type of biomass, time frame, system (mandatory / voluntary) and demands of their criteria.

Table 6: Overview of involvement of stakeholders in process of biomass certification

Initiatives	Principles	I & C[25]	Status	Organization	Platform function
National Governments					
Netherlands	Yes (environment, socio-economic)	Yes	Pilot studies	Working group set up by government	Stakeholder consultation
Belgium	Yes (GHG, sourcing)	Yes	Certification needed for green certificate	Independent body recognized by authorities	
UK	Yes (GHG, more possibly in future)	Yes	Standardized certification expected in 2008	Legislation development (RTFO)	Stakeholder consultation
Canada	ECOLOGO (general), also for biomass	Yes	Since 2005	Government owned label	
Brazil	Social Seal for biodiesel	Yes	In implementation	Government regulation	
Germany	Expected in Mid 2007	No	Draft expected	National regulation	
Other government[26]	No	No	Not applicable	Not applicable	Partner in debate
E.C.	Yes, in development	No	Tender in September 2006	Policy development within EU	Partner in debate
Companies					
Essent	Yes (Environmental criteria, social criteria in development)	Yes	Green Gold Label	Independent body: Control Union	IEA Task 40 member
Electrabel	Yes (Sourcing, energy / GHG balance)	Yes	Electrabel label	Independent body: SGS	Member IEA Task 40
BioX	Based on RSPO criteria	n.a.	Auditing palm oil locations	In cooperation with Control Union	RSPO member
DaimlerChrysler	In development	No	Studies, discussion, forum	Initiative in coop. with UNEP	Forum for environment
Volkswagen	Tax model incl. criteria	Yes	Model development		Partner in debate
Shell	Studies on sustainability biomass	No	Studies, small projects	Under framework of BUS initiative	BUS Forum of experts
Rabobank				Financing partner	Partner in debate

[25] I & C: Indicators and Criteria

[26] Various governments have started policy developments on biomass and biofuels, mainly focusing on stimulating the use of it by defining targets or policy incentives, see section 3.1

Initiatives	Principles	I & C[25]	Status	Organization	Platform function
Others[27]	No	No	Position papers	Not applicable	Partner in debate
NGOs					
WWF	Yes	Yes	Road map	Approaches, see study WWF Germany	RSPO member
Solidaridad	Yes (based on own label)	Yes	Project with case studies	Project in coop. with GGL (Essent)	Involvement stakeholders
NGOs Netherlands	Yes	Yes	Proposals for policy tools, pilot studies	Study assigned by Dutch NGOs	Participation in debate (RSPO)
NGOs South Africa	Standpoints on concerns biofuel production	No	Position paper	Working group representing NGOs	
NGOs Germany	Yes	No	Policy Paper	Study through stakeholder process	
NGOs Brazil	Sustainability criteria	Yes	Report	Developed by various NGOs	
IATP	Sustainability criteria	No	Criteria combined with good practice	Through stakeholder process	
Others	Limited	No	Position papers[28]	Not applicable	Partner in debate
International organizations, initiatives					
UN-Energy	No	No	Not applicable	Platform (non-) UN organizations	Coordination, exchange info
UNBI	Background studies in trade & potential	No	In planning	UNCTAD chairs initiative	Coordination, support
FAO	Yes, for forest biomass	Yes	Pilot studies	Partner is IEA Task 31	Partner in debate
UNEP	In development	No	Preparatory studies	In coop. with other organizations	Partner in debate
IBEP	Background studies	No		FAO chairs initiative	Knowledge exchange
G8 GBEP	White Paper	No	No	Initiative within G8 countries	Coordination
EUGENE	Yes (sourcing), additional P in process	Plan	Existing label, additional C&I	Network for green labels	Networking function
RSPO	Yes, for palm oil production	Yes	Pilot studies and working group	Roundtable on voluntary basis	Stakeholder process, platform
RTRS	Planned for soy production	Plan	No	Roundtable on voluntary basis	Stakeholder process, platform
BSI	Planned for sugarcane production	Plan	No	Roundtable on voluntary basis	Stakeholder process, platform

[27] Companies as Unilever, Cargill and CEFETRA are actively involved in the discussion on biomass certification issues, e.g. as member in the project group Sustainable Biomass in the Netherlands

[28] Various NGOs (Greenpeace, Birdlife) have published a position paper to express their views on biomass and biofuels in the EU and worldwide. Lists of Concerns are expressed in these papers, see section 3.3

4. Limitations for the implementation of a biomass certification system and possible strategies to overcome them

This chapter looks at the role of the World Trade Organization (section 4.1) in relation to international biomass certification, as regulation of international biomass standards has to comply with WTO rules. Section 4.2 discusses limitations and counter arguments for implementing a biomass certification system and possible strategies to overcome them.

4.1 Biomass certification and international trade law

The rules of the *Technical Barriers to Trade* (TBT) Agreement stipulates that both regulations (mandatory) and standards (voluntary) create unnecessary obstacles to trade and prohibits discrimination between domestic products and foreign products that are alike (the *national treatment principle*[29]) and between 'like products[30,] from different WTO members, called the MFN, the '*most favoured-nation principle*[31,] (Bauen *et al.* 2005). The MFN and national treatment obligations apply only if two products are "like".

[29] National treatment principle: forbids members from treating foreign products less favourably (for example through more stringent regulation) than domestic 'like products'.

[30] 'Like products' refer to products with the same or similar physical characteristics or end uses

[31] The most favoured nation principle aims to prevent members from treating products imported from one WTO member less favourable than 'like products' from another member.

Table 7: Started initiatives for a biomass certification system (+ criteria are included, - criteria are not included[32])

Check list:	Green Gold Label	Electrabel Label	Government (BE)	UK-RTFO	Project group (NL)	EUGENE (EU)	RSPO
Type of biomass	Biomass (all), complete chain	Biomass (all), complete chain	Biomass certificate, energy generation	Biomass source for biofuels	Biomass (all)	Focus on end part of chain	Palm oil production, production side
Status	Certification in implementation, also in development	Certification in implementation, also in development	Green certificates linked to GHG / energy criteria	Establishment certification in development	Principles developed, testing phase C&I (pilot studies)	Actual label, adds extra principles for biomass in specific	Principles developed, testing phase C&I (pilot studies)
Principles included:							
GHG and Energy balance	-	+	+	+	+	+	+
Biodiversity	+	-	-	- [33]	+	-	+
Competition of food supply, local sources	-	-	-	-	+	-	-
Leakage	-	-	-	-	- [34]	-	-
Economic well-being	- [35]	-	-	- [18]	+	-	+
Welfare / social criteria	- [16]	-	-	- [18]	+	-	+
Environmental criteria	+	+	-	- [18]	+	+	+
Procedure and organization:							

[32] This is a general overview. When a criterion is included (+), the level of detail in methodology, indicators etc. may still vary per certification system.
[33] With future development of the system, other sustainability principles (environmental and social criteria) will be addressed
[34] Currently investigated how to take this into account
[35] The inclusion of socio-economic principles are taken into consideration

Check list:	Green Gold Label	Electrabel Label	Government (BE)	UK-RTFO	Project group (NL)	EUGENE (EU)	RSPO
Type of system	Track-and-trace Sourcing	Track-and-trace Sourcing	Cooperation with e.g. Electrabel, SGS	Track-and-trace Sourcing	Track-and-trace Sourcing	Track-and-trace Eligible sourcing	Track-and-trace Sourcing
Organization	Established by company Essent, now open for 3rd parties	Label is developed by company Electrabel	Government provides green certificate based on criteria compliance	Initiated by government, organizational structure in process	Initiated by government, organizational structure in process	European Network of green energy labelling bodies	Roundtable with stakeholders in palm oil production
Verifier	Control Union	SGS	See Electrabel	Not applicable	Not applicable	Independent 3rd party verification	Verifier working group (in progress)
Relation to national policies	Stimulated by policy	Required by law	In regional policy (in development)	Plans to embed in national policy	Plans to embed in national policy	On voluntary basis	On voluntary basis
(Plans to) make use of existing systems	FSC, 'Organic' certification	Yes (e.g. FSC)	See Electrabel	Yes (e.g. FSC)	Will apply e.g. FSC, RSPO, GGL	Yes (e.g. FSC)	Makes use of existing systems

'Likeness' is determined on a case-by-case basis by four criteria (WTO 2006b): a) the properties, nature and quality of the product; b) tariff classification; c) consumers' tastes and habits and d) product end use. Environmental trade measures to distinct between products based on their production *process and production methods* (PPMs) that do not in any way influence the physical characteristics of a product may violate the TBT obligations (Wessels *et al.* 2001), see for some examples from PPMs (WTO 2006b), (Wessels *et al.* 2001) in annex 13. This is important to consider, as criteria related to sustainable biomass certification are likely to be based on non-product related criteria. The more remote the distinguishing criteria are from features (albeit non-physical) that consumers can associate, if properly informed, with a particular product, the more probable the products themselves are considered to be 'like'(Howse *et al.* 2006).

At present, the applicability of the provisions of the TBT Agreement that are based on non-product related PPMs is unclear. The relevant jurisprudence is not conclusive, and authoritative authors are divided on the subject (Zarrilli 2006). The Appellate Body in Asbestos (see annex 13) has interpreted jurisprudence on the setting of PPM-based regulatory requirements: In the case of PPMs, the Appellate Body has emphasized that regulatory distinctions may be drawn between products found to be 'like,' provided that the distinctions in question do not systemically disadvantage imports over domestic products (Zarrilli 2006)[36] and the complainant would also have to establish that the 'like' imported product has been afforded less favourable treatment than the domestic product (Howse *et al.* 2006). The jurisprudence is applicable, e.g., to measures relating to post-import environmental impacts. Measures to minimize the overall impact of a fuel throughout its lifecycle on global carbon emissions do not seem to interfere with local or domestic policies either as it relates to a global environmental problem (Howse *et al.* 2006).

The latter example also relates to the text of GATT (article III.) stating few exceptions, which makes trade restrictions in the interest of conservation and animal and plant health permissible, even though they violate the general principles of GATT. These exceptions may justify *environment-related measures* on products and the use of necessary measures to assure these standards are met when a) necessary to protect human, animal or plant life or health or 2) relating to conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption (Bauen *et al.* 2005). Air is considered as an exhaustible natural resource and the argument of adequate supply of (sustainable) biofuels within this context has plausibility as well (Howse *et al.* 2006). Another exception relating to GATT is the National Security Exception (article XXI GATT) that allows taking necessary measures for the protection of a country's national interest. It is acknowledged that energy security is a vital dimension of national security in general (Howse *et al.* 2006).

No provisions exist within WTO agreements for linking trade with social issues and labour standards, and any attempt to make such linkages has so far been met with opposition. However, the International Organization for Standardization (ISO) has recently launched the 'Working Group on Social Responsibility' with the task of publishing ISO26000 standard on guidelines for social responsibility in 2008 (Bauen *et al.* 2005).

Thus, based on above, it seems to be possible to design environmental measures and sustainability criteria for biomass (in line with the general principles of TBT and MFN Agreements) that distinguish 'like products' when they are:

- Relating to post-import impacts (visible in end use of product)
- Referring to a global scale (e.g. GHG levels) with no interference with local policies
- Based on based on consumer preference, unspecified to a specific product and translated to voluntary standards. These can include environmental or socio-economic criteria
- Needed to a) to protect human, animal or plant life or health or 2) relate to conservation of exhaustible natural resources (criteria applicable are e.g. air emissions or GHG balance).
- Internationally agreed upon with broad consensus. This is more complicated for criteria with impacts on local / regional level (e.g. harvesting methods, soil quality with impacts varying from place to place). Also no international provisions exist within WTO agreements for linking trade with social issues and labour standards.

[36] How this jurisprudence applies to biofuels and related feedstock[1] is still unclear and an open debate . It can be argued that the Asbestos case also showed a physical difference between products as the presence of Asbestos can or cannot cause cancer. This health aspect is specifically present in this case.

International standards should be used where appropriate but the TBT Agreement does not require members to change their levels of protection as a result (Fritsche, U. *et al.* 2006b). *The Code of Good Practice* (annex 3 of TBT) provides disciplines to standardising bodies, including those related to transparency, for preparing, adopting and applying standards (Wessels *et al.* 2001). In general, international consensus of criteria and broad consultation among states, taking into account the variety of conditions in diverse countries promotes their acceptance between WTO members (Howse *et al.* 2006). Based on previous concerns and debates in the 1990s (annex 13) regarding the use of the Code, especially with reference to voluntary eco-labelling schemes, it was agreed that there should be a) an open market for all certification schemes b) no political action to diminish the trade of uncertified products and b) no inclusion of the origin of the timber on the label to avoid discriminatory action against specific regions (FASE-ES 2003). Thus:

- There is an open market for certification system with a risk for proliferation of systems
- International consensus promotes acceptance of criteria and the Code of Good Practice can serve as a tool to promote transparency and stakeholder participation

The possibility to link sustainability standards to *subsidies and tariffs* may affect international trade and is therefore included in WTO rules. The *classification of a product* is important to define which tariff levels and which set of disciplines and domestic subsidies are applicable. The tariff classification applicable to e.g. biofuels is classified as agricultural or chemical goods and not specifically specified as fuel. The Agreement on Agriculture (AoA), with separate rules on subsidies and tariff rates, also applies to trade in ethanol (Howse *et al.* 2006). Ethanol was also included in two product lists of potential candidate goods for 'environmental goods' by OECD and APEC (Fritsche, U. *et al.* 2006b). The fact that product classifications are not consistently aligned with the actual consumer market in question (e.g. ethanol on fuel market) leads to a number of problems with respect to consistency, certainty and non-discrimination of existing WTO obligations. An approach would be to define 'new' products for biomass-derived energy carriers. However, this is a complex process which can take many years (Howse *et al.* 2006).

Subsidies are arranged in the AoA and the SCM[37] Agreement, the latter prohibiting export subsidies and subsidies contingent upon the use of domestic products over imported products. Complaints against subsidies may be addressed and therefore should (Howse *et al.* 2006):

- Not have certain kind of adverse trade affects
- Be non-specific, not directed at limited group of particular products
- Not cause adverse effects (injury) to a group

Within the AoA, countries have agreed to pursue the harmonization of subsidies. A number of approaches allow countries to subsidize products. 'Green boxes'[38] are permitted. In order to qualify for the "green box", a subsidy must not distort trade, or at most cause minimal distortion; they have to be government-funded and must not involve price support. They tend to be programmes that are not directed at particular products, and include direct income supports for farmers that are not related to (are "decoupled" from) current production levels or prices (WTO 2006a). At this moment "green box" subsidies are allowed within WTO but may be difficult to maintain if liberalization of the agricultural sector progresses (Fritsche, U. *et al.* 2006b).

4.2 Limitations on the implementation of biomass certification and possible strategies to overcome them

Limitations mentioned in studies and pilot projects on the development of a biomass certification system provide lessons learnt for future implementation. Besides, not everyone sees certification as a means to guarantee sustainability and counter arguments, especially based on experiences in certification from forest and agricultural products are also heard.

4.2.1 Lack of adequate criteria and indicators

There is not yet consensus which criteria should be included to guarantee sustainable biomass trade and how less quantifiable targets should be measured (WWI 2006). An implication

[37] SCM: Subsidies and Countervailing Measures
[38] In WTO terminology, "boxes" identify subsidies

mentioned for the development of a biomass certification system is to make some of the concerns and sustainability principles[39] operational into effective indicators and verifiers. There is experience in applying some and little to no experience of applying others. Better insight is e.g. required on how to design criteria and indicators according to the requirements of a region and how to include the avoidance of leakage effects and the influence of land use dynamics (Faaij *et al.* 2006). Other issues mentioned by (WWI 2006) are e.g. 'how to measure impacts on habitat and wildlife in economic terms?' and 'how to ensure that biomass production does not crowd out the production of much-needed local food sources?'

Similar concerns were mentioned in a discussion of three case studies from Indonesia, Brazil and South Africa (BothEnds 2006) on the sustainability of biomass questioning how to deal with leakage effects, e.g. Sugarcane (rising prices) in Brazil might replace soy or cattle areas and, as an effect, soy and cattle areas move to degraded or newly converted lands. Another question dealt with how to define the system boundary to be considered for sustainability criteria, e.g. an agricultural field can be sustainable but the sector as a whole might be unsustainable or create leakage effects. Also, a positive effect for one criterion might create a negative effect for another and the question is how to deal with this.

It is recommended to develop pilot studies to build up experience of how sustainability criteria can be met under diverse conditions (Cramer *et al.* 2006). Also, the development of new methodologies to measure impacts and valuation approaches on how to assess overall damage and benefits (Smeets *et al.* 2006) are needed.

4.2.2. Requirement of effective control and monitoring system

The report from (ProForest May 2006) gives insight in procedures needed for a reliable certification system, including the need for a solid documentation system, which is able to deal with all the systems of processing, storage and transport. Clear procedures and the availability of critical control points are needed as well. The establishment of a reliable international biomass certification system is further complicated due to large differences between regions in production and scale (monocultures, small scale, different crops), national context (legislation in place, stakeholders and their view on sustainability) and environmental vulnerability (drought, fire, soil) etc. This was also mentioned in the pilot studies from (BothEnds 2006). Effective and reliable monitoring of a wide range of biomass sources within these local differences is a challenge. Besides, NGOs have indicated in several cases that the frequency of field visits is often too low. If stricter monitoring is required, this will also have an impact on certification costs. How, in this light, a certification system would have to be given shape must, therefore, be worked out further (Cramer *et al.* 2006).

It is advised to design and adopt specific, quantifiable criteria for sustainability indicators. Despite their specificity, they should be flexible enough to be adapted to the particular requirements of a region (WWI 2006). Quantifiable and qualifiedly criteria have to be easily comprehended and controlled. More insight is needed in the monitoring compliance and limitations of sustainability criteria developed for biomass (BothEnds 2006) while ensuring that this is enforceable in practice, without generating high additional costs (WWI 2006).

(WWI 2006) sees the incremental development of a certification scheme as the most feasible option, allowing for gradual learning and expansion over time. (Cramer *et al.* 2006) recommends that a biomass certification system must initially be founded on a track-and-trace system, in which the traceability of the biomass is guaranteed. A consideration here is that complete traceability in the short term is practically impossible. That is why a transition period will be necessary.

4.2.3 Open market limits effectiveness certification system

(FASE-ES 2003) mentions that the open market for (in this case) FSC certification has transferred the responsibility for 'combating environmental and social crime from governments to consumers faced with hundreds of eco-labels, the vast majority of which are a result of opportunistic product

[39] The study from provides an overview of major concerns of the impact of biomass trade that are addressed in discussions about criteria for sustainable biomass trade.

marketing'. This competition has led some certifiers to lax application of the FSC-standards, i.e. by including the formulation that criteria have to be fulfilled 'within a certain timeframe' after the certificate had been issued. This resulted in abuse of the possibilities of the system. (WWI 2006) indicates that open competition in certification schemes and –therefore- confusion for consumers has hampered efforts to develop meaningful certification systems in eco-tourism and organic foods. (FASE-ES 2003) also mentions that certifiers often have a commercial relationship through direct contracts with the certification client, which results in an interest of the certifiers in a positive assessment that weakens the objectivity of the problem.

(WWI 2006) recommends that a proliferation of standards that differ from one country or region to another have to be avoided. Further coherence in biomass certification systems, possibly through promotion of international agreements and standardization of criteria, is needed.

4.2.4 Small stakeholders' limitations to implement requirements

Smallholders are usually operating with limited resources and technical skills and may lack the capacity (knowledge, financial resources) to implement the necessary changes (ProForest May 2006). Compliance with a complete new certification system in short time may be too complicated for producers, especially for smaller companies. Only larger producers can fulfil new demands in short time. This contains a risk for marked disturbance as only few producers can offer certified feedstock, which may lead to artificial high prices (Maris 2006). While a certification scheme should be thorough, and reliable, it should not create a hurdle for nascent industries (WWI 2006)

It is therefore important to pair a certification scheme with technical assistance, incentives, and financing, so that smaller producers can qualify as readily as larger producers (WWI 2006). Making use of existing certification systems ('benchmarking') in the development of a biomass certification, at least for the short term, may promote the involvement of smaller stakeholders. Existing systems may not cover all required criteria (maybe 90%) but have less impact on the market. Including extra criteria in a certification system can then be achieved over time by mutual consultation (Maris 2006). Beside, it is recommended to look for possibilities for group certification to guarantee that small producers are not excluded (Cramer *et al.* 2006).

4.2.5 Involvement stakeholders required for reliable system

While expert judgment can flag the issues, alert the stakeholders to major concerns and provide methodologies for measuring, valuating and monitoring the different aspects, experts should not unilaterally decide which sustainability criteria to include and how to prioritize them. To a large extent, the judgement of local stakeholder is also crucial to take into account the circumstances and needs in specific situations.

Furthermore, an adequate understanding and involvement of primary processors in the supply chain at the level of control at primary processing units is important to the credibility and security of the entire chain of custody (ProForest May 2006). This is confirmed by Ortiz (2006) mentioning that involvement of workers in the field, often controlling the criteria in the field, is required for successful implementation of a biomass certification system. However, their involvement in the strategic development of the criteria, as e.g. currently developed in Europe, is often limited and starts (too) late in the process. It is therefore important that all concerned and affected in a participatory process (multi-stakeholder approach) set certification criteria (Maier *et al.* 2005).

Main arguments given about participation failures in certification systems by (FASE-ES 2003) are that the selection of consulted groups is often arbitrary, tending to include most influential actors while local groups, as small farmers, are often neglected. Beside this, people without access to modern communication channels (i.e. indigenous groups or rural people) are often not informed. Also, there is often a gap of 'technical expertise' between certifiers or other specialists and the local population. And, in case of questions or problems raised, more detailed studies are often not included in the budget of the certification assessment.

For a successful implementation of a biomass certification system, it is recommended to achieve consensus among diverse stakeholders about basic underlying principles. Broad consultation and

participation in the process is required for any (voluntary) system to be credible in the marketplace (WWI 2006). Where strict, specific criteria and indicators are difficult to establish due to differing opinions of stakeholders, the use of so-called “process indicators” that show continuous improvement may help facilitate progress in moving forward (WWI 2006). The WWI (2006) mentions that relying on existing certification systems should be approached with caution, as they may represent (or be perceived to represent) only some of the stakeholder interests.

4.2.6 Limitations related to (inter-) national legislation and international trade

A biomass certification system needs to comply with international (see 4.1) and national legislation. Compliance with national legislation is a minimum requirement in most existing certification systems. A study from (Smeets *et al.* 2006) on sustainability of Brazilian bio-ethanol mentions a weak government and law enforcement system as one of the implications related to national legislation. This is also acknowledged in the case studies from Indonesia, Brazil and South Africa (BothEnds 2006) mentioning that lack of spatial and land-use planning can increase risks for local food security and leakage effects. Lack of land certification is another concern mentioned, limiting the position and rights of local communities. Although legislation might be in place, a weak governmental and law enforcement system in developing countries to ensure compliance of these laws may remain a problem (see also 4.2.2).

Additional control mechanisms might be required in countries with weak governmental and law enforcement system. Support is needed to national governments to improve their law and enforcement systems.

4.2.7 Cost levels of biomass certification

Compliance with criteria has to be controllable in practice, without incurring high additional costs (Faaij *et al.* 2006). Within the frame of additional costs for the sustainable production of biomass and certification, basically two different cost aspects are identified (Cramer *et al.* 2006):

- Additional costs to meet sustainability criteria for the production and transport of biomass (e.g. measures against soil erosion or an additional wastewater treatment facility).
- Costs for monitoring the compliance with the sustainability criteria and the physical traceability of the product; Components of these costs are e.g. the costs of field study by a certifier or administrative costs. Also, there are costs of physical traceability (chain of custody/track-and-trace), e.g. the sampling of palm oil during loading and unloading.

For both cost items, a brief attempt to quantify the possible cost ranges, based on existing sustainability schemes and certification systems, is included in annex 5. Based on these data, it can be concluded that the cost for complying with (strict) sustainability criteria can be substantial; a range of 8-65% was found in literature, though incidentally also a slight cost reduction was reported. Costs are strongly related to the scale of operation and the number and strictness of sustainability criteria (Cramer *et al.* 2006). Costs are also greatly dependent on the number of sustainability criteria and the expertise required, e.g. an FSC-inspection will roughly cost about five times as much as an inspection for ISO standards. Estimations of costs amount to between 0.1 - 1% of the overall costs of the main product, largely depending on the scale. In the bulk markets for agrarian feedstock a track-and-trace system will, however, lead to the necessary logistical and practical problems and the costs involved. This applies particularly to the liquid fuels, in which it will be difficult and very expensive to keep the different parties apart (Cramer *et al.* 2006).

Costs for enforcing and monitoring are greatly dependent on the scale of the production company. Large companies can easily pay the costs of monitoring, small companies less so. Related to this, is the question ‘who will pay?’ for the process of establishing a scheme, or for certification itself, or enforcement. This question is important for e.g. (WWI 2006) to ensure that standards and certification programs do not hurt smaller stakeholders or developing nations. (Zarrilli 2006) mentions that developing countries have traditionally encountered difficulties getting certificates (see 4.2.4) issued by their domestic certification bodies recognized by the importing countries and often need to rely on (expensive) services provided by international certification companies.

Certification costs depend largely on operation of scale, expertise required, strictness and number of criteria. Issues of cost and who pays are therefore critical to the success of a certification program, particularly when seeking participation of smaller-scale producers with fewer resources (WWI 2006). It is recommended to make as much as possible a link with existing certification systems to limit administrative burdens and costs where possible (Cramer *et al.* 2006). See also section 4.2.4

4.2.8 Issues related to inequalities in development and trade

There is a concern is that biomass certification can become an obstacle for international trade and develop trade restrictions due to the proposed sustainability criteria. Measures to ensure conformity can act as powerful non-tariff barriers (especially for developing countries) if they impose costly, time-consuming tests (Zarrilli 2006). Also, some sustainability indicators under development go beyond indicators developed in many other sectors and it should be avoided that this backfires on biotrade if too many restrictions are put in place (Cramer *et al.* 2006).

Related to this issue, (WTO 2006b) mentions a number of arguments why not to distinguish between products on the basis of how they were made (i.e. on basis of sustainability criteria).

- If one country sets rules (such as requiring eco-labels), which deals with the way products are made in another country, then it is intervening in the producing country's rules.
- When products are identified only by what they are, not how they are made; countries can set their own standards as appropriate for their level of development. Countries can then make their own trade-offs between their needs for development and for environmental protection, according to how they themselves value these needs
- If countries do not impose their (environmental) standards on each other, standards can be tailored to different conditions, priorities and problems in different parts of the world, including varying ability to absorb pollution.

It is recommended to develop sustainability criteria through a transparent and fair process where countries, both consuming and producing, are effectively presented (Zarrilli 2006). Criteria and related schemes should be easy to apply and flexible enough to take into account local conditions (Zarrilli 2006). Support is needed to improve developing country's capacity to play an active role in the development of biomass certification (Zarrilli 2006). Also, it must be kept in mind that there is a large diversity in the technical efficiency level in biomass production in the world (WWI 2006) ranging from large-scale, high-tech production to smaller-scale, low-tech biofuel production focused primarily on poverty alleviation. The appropriate technologies and policy orientations required to promote these two objectives are different. Policymakers need to clearly define their outcomes and design policies accordingly. The more high-tech and large-scale biofuel industries become, and the more involved large companies become, the greater the policy effort required to fulfil social and environmental aims (WWI 2006).

5 Proposed strategies for implementation of a biomass certification system

Certification is one of the policy tools available to pursue the sustainability of biomass and other policy tools to pursue sustainability standards are (Richert *et al.* 2006):

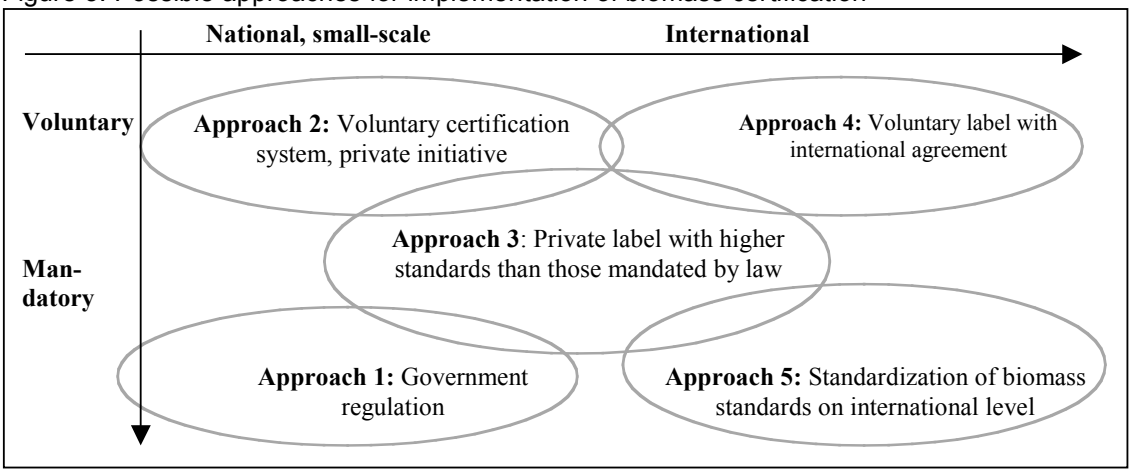
- *Certification*: Only biomass that is certified according to criteria derived from sustainability principles is allowed to be imported as a result of government support for bio-energy production
- *Product Land Combinations*: Only biomass coming from regions that comply with sustainability principles are allowed to be imported as a result of government support for bio-energy production. Government decides which products from which regions are eligible for government sponsored bio-energy production.
- *Regionalization:* In this strategy, Europe utilizes its own biomass resources before importing biomass from developing countries.

Table 8: SWOT analysis for certification to pursue sustainable biomass (Richert *et al.* 2006):

Strengths	Weaknesses
• Flexible in land choice; • Clear translation 'do no harm' possible; Connects to approach NGOs to stimulate forerunners (promotes continuity)	• Controllability system is low (control by private parties) • Political discussion on approach & considerations lacking • Translation "do more good" is limited; • Expensive (administration is expensive for companies and therefore difficult to apply for small holders); • The system is inflexible once a standard is developed (in practice it turns out to be difficult to adapt a standard);
Opportunities	**Threats**
• Certification is not dependent of a national political context so that local initiatives can be rewarded • Independent of the developments in a country; Netherlands develops a standard and can be used by others;	• Because of decentralized implementation, there is a risk that the quality of certificates is variable; • Due to low technical feasibility of high quality certification, there is pressure to weaken quality of standard; • Is applied without consideration, automatism

The three tools were analyzed through a SWOT analysis and by scoring the effectiveness, the technical, juridical and political feasibility and the time needed to implement the tool. Advantages and disadvantages for certification as policy tool in specific (Richert *et al.* 2006) are included in table 8. In this section, we discuss proposed strategies and pathways for the implementation of a biomass certification system as can be found in several studies and in literature. Five main strategies can be distinguished (see figure 3), which will be discussed one by one.

Figure 3: Possible approaches for implementation of biomass certification



Approach 1: Government regulation for biomass (minimum) standards

The first approach is based on a government regulation for biomass minimum standards, possibly combined with incentives (J. Cramer 2006). This approach coincides with e.g. the viewpoint of (WWF 2006b) that 'promotes the adoption of a mandatory GHG certification scheme for all biofuels, whether produced in the EU or imported, combined with reporting obligation for environmental and social sustainability issues with a view to improve performance over time. (Maier *et al.* 2005) also favours this approach mentioning that the EU must insist upon the development of an eco-fair certification scheme for sustainable bio energy sources, which guarantees privileged market access to the EU.

Initiatives to embed biomass certification into national policy can be found in countries as UK, Belgium and the Netherlands (see section 3.1).

Approach 2: Voluntary certification system, bottom-up approach
A possible approach is the *bottom-up approach* (Uwe R. Fritsche 2006). A group of governments, companies, and other interested parties could voluntarily adopt standards and certification schemes, as e.g. the RSPO has done. Collaborative certification schemes could be a starting point, setting minimum standards for cultivation and harvesting practices for producers. As trade increases in volume and complexity, a more advanced and innovative certification scheme may build off of earlier efforts. While not all biomass types may fulfil the entire set of sustainability criteria initially, the emphasis should be on the continuous improvement of sustainability benchmarks (WWI 2006).

Relevant in this approach is to see which player can take the lead in the process. Also, time and interest is needed to introduce and implement standards. Existing instruments or organizations can be used to push the process, e.g. bi- and multinational financing institutions are relevant players in this process to start implementing sustainability standards for their project (co-financing) operations (Fritsche, U.R. *et al.* 2006a). Currently, two voluntary certification systems (GGL and Electrabel) that cover the complete biomass chain are in implementation. Other certification systems are under development (see section 3.2 and table 9).

Approach 3: Private label with higher standards than those mandated by law
As part of a voluntary certification scheme, it would be possible to develop an eco-label for those biomass related products that meet higher than those mandated by law (WWI 2006). The object of certification is a governmental regulation for biomass minimum standards combined with a set of private standards. Higher standards or special cases are based upon voluntary agreements of biomass producers. The latter would include companies in the chain of custody whose statutes or internal regulations contain several biomass standards and being based upon goodwill (Fritsche, U.R. *et al.* 2006a). In this approach, there are several institutions that can take care for the certification (controlling compliance of criteria) of biomass: Governmental institutions (certification with regard to governmental guidelines) or private certification institutions (governmental guidelines combined with stricter private guidelines) (Fritsche, U.R. *et al.* 2006a).

An example for this approach can be found in the UK (see section 3.1) considering to link GHG certification to RTFO and to cover other environmental and social criteria by a separate voluntary scheme, developed by industry stakeholders (Bauen *et al.* 2005).

Approach 4: Voluntary bio-energy label combined with international agreement
The promotion of international general agreements on 'well functioning global markets for bio-energy is suggested by (Hektor 2006). These agreements could be established through written general guidelines or 'codex of behaviour' for the direct actors involved. A similar kind of approach is suggested by (Verdonk 2006) giving proposals for governance systems for bio-energy, based on a comparative case study research on the governance of comparable commodities as e.g. coffee and wood. The proposal results in a system consisting of two pillars: a bio-energy labelling organization (BLO) and an International Agreement on Bio-Energy (IAB).

The first pillar is the BLO that offers a FSC based certification system that is able to penetrate the market within a short time, offering stakeholder participation and standards that secure most sustainability concerns. By being compatible with neo-liberalism, the BLO seems acceptable to the industry and the WTO. The attractiveness for small and southern producers is enhanced in this system using Fair Trade based instruments, but remains in balance with downstream interests at the same time. The framework of universal sustainability principles enables geographical differentiation of standards and accommodation of numerous bio-energy feedstock. In order for the BLO to be manageable in the starting phase, it is proposed to limit the number of bio-energy feedstock and/or the number of sustainability concerns in its starting phase. Within time, the scope can be further widened (Verdonk 2006).

Because the BLO suffers from dependency on conscious consumers, governmental intervention through a United Nations Agreement on Bio-Energy (UNAB) was originally proposed in order to realize a significant market penetration (the 2nd pillar). However, as the establishment of an UNAB was considered as a bridge too far (based on interviews), an alternative option is the development of an International Agreement on Bio-Energy (IAB) by front running (Western) countries. Western

countries are assumed to have less divergent views on sustainability and foreign politics and have already markets for sustainable production

Table 9: characteristics of the proposal (Verdonk 2006):

Instrument	Description	Purpose
Pillar BLO:		
Progressive certification	Multiple levels of compliance on sustainability criteria	Certification of production; Enables participation of many producers
Progressive price premium	Linked to the level of compliance and product quality	Incentive for producers to participate and to increase the level of compliance
Impact assessments	On local economy, food & energy supplies, complementary GHG using LCA studies	Prevents leakage effects and food & energy shortages; ensures GHG complementary
Marketing assistance	Advice programs on certification and organizing trade relations; certification subsidies for small & Southern producers	Enhances involvement of and benefits for small & Southern producers
Buyers groups	Actors from industry and civil society	Stimulate demand of BLO certified bio-energy
Monitoring	Chain-of-custody certification	Certification of trade
Pillar IAB:		
Covenants	Agreement between industries and governments	Increases use of BLO certified bio-energy
National import & production rules	Based on BLO certification	Limits import and production of non-BLO certified bio-energy
Regulation of market prices	Internalize environmental costs in prices energy	Lowers the price difference with unsustainable sources of energy

Approach 5: Standardization of biomass minimum standards on international level
An option for regulating sustainable biomass standards internationally in a legally binding form would be through the adoption of a multilateral environmental agreement (MEA) or by integrating the standards into existing international agreements or standards (Fritsche, U. *et al.* 2006b). Recommendable on international level is an agreement on the objectives about standards for bio energy. The framework conditions for bio energy should be regulated from which criteria for different sectors can be further established. Further step of refinement of these standards can take place to regional level with regard to objectives and conformation to the regional legal framework. This regulation can go beyond the minimum criteria of the international agreement and concrete instruments can be applied (Fritsche, U.R. *et al.* 2006a).
No international agreements (voluntary or legally binding) exist yet for sustainable biomass standards. However, on a regional supra-national level, the EC is currently developing standards and a policy framework to secure sustainable biomass for the European region (see section 3.1).

6. Discussion

In this section, strategies (section 5) for the implementation of a biomass certification system are discussed (section 6.1) followed by a discussion on possible roles of stakeholder groups in the development of such a biomass certification system (section 6.2).

6.1 Recommendations in development of a certification system

The approaches as mentioned in chapter 5 are discussed based on the indicators used in the study from (Verdonk 2006) and concerns indicated in section 4.3.

6.1.1 Stakeholder involvement

The success of a biomass certification system depends largely on the involvement and support of the wide range of parties involved in the biomass production, trade and processing chain. Full involvement of all stakeholders, including small stakeholders, is advisable. A bottom-up approach (approach 2) includes the interest and involvement of all relevant players. Roundtables as RSPO serve well as forums to discuss topics relevant for biomass certification between stakeholders and reach common agreement on it. This approach requires a strong commitment of the stakeholders involved as it lacks an obligation for the market to fulfil the sustainability criteria. This diminishes a

guarantee for international sustainable biomass trade. To secure sustainability concerns (see 5.1.2) some governmental intervention might therefore be required. Top-down approaches (approach 1, 5) involve the risk to exclude smaller stakeholders, which are needed though for the controllability and implementation of a biomass certification system.

6.1.2 Securing sustainability concerns

Most stakeholders agree that a set of environmental, social and economic criteria should be included in a biomass certification system. The security of sustainability concerns depends to what extent these are translated into the certification system. At this moment, various organizations are preparing principles or criteria (see section 3) but only few have started to bring them into practice. Limited experience in the translation of some of these concerns for sustainable biomass production into indicators and verifiers (as leakage or competition with food) making it difficult to get the criteria operational in practice (see 4.2.1). This leads to a tendency to simplify the sustainability criteria for the short term, taking into consideration extra criteria for the future. Weakening the criteria may create a risk for securing the sustainability of biomass. As there is a need to secure the sustainability of biomass in a fast growing market, a gradual development of a certification system with gradual learning (to gain insight and experience in criteria) and expansion over time seems to be desirable (approach 2,3,4). Making use of lessons learnt from existing systems (or in development) may be part of the solution for the short term.

A consideration in the development of a biomass certification system is whether a certification should be legally binding or with restricted or no binding force. Sustainability concerns are more secured in a certification system where standards of a certification system are (partly) translated into policy instruments (approach 1, 3, 5) than in a voluntary certification system (approach 2). However, there is a limitation to the extent that criteria can be regulated (see also 6.1.4)

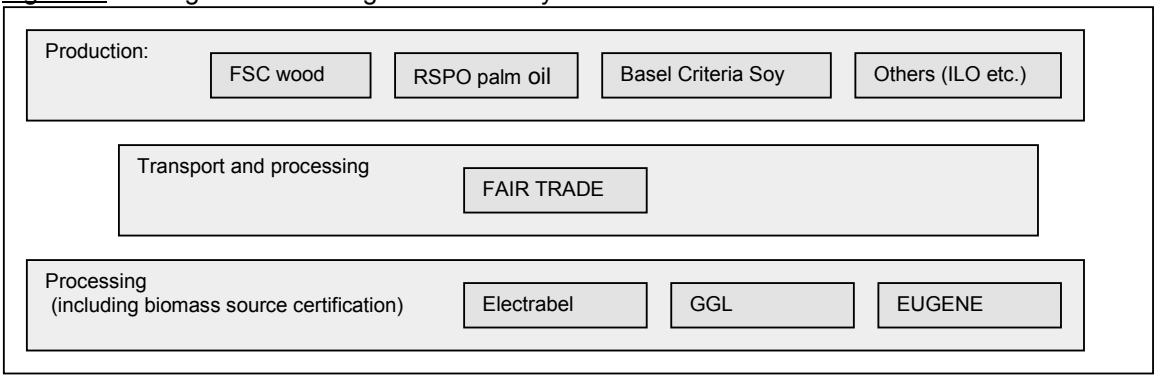
6.1.3 Level of flexibility (regional refinement)

Environment, policies (6.1.5) and possible implications vary from place to place (see also 4.2.2) and a possibility for regional refinement of standards is therefore relevant. A developed voluntary or government regulated certification system (approach 1,2,3,) may turn out to be, once standards are developed, inflexible (see also table 11). A framework with minimum standards may enhance the flexibility of a system, as national or local relevant standards can be set (approach 5).

6.1.4 Feasibility in costs

Criteria need to be controllable in practice, without incurring high additional costs. At this moment, existing biomass certification systems (see table 7) have included environmental criteria to limited extent compared to the sustainability principles developed by various NGOs and governments. Socio-economic criteria are not included yet or only to a certain limit. To comply with the complete list of criteria (as proposed by various stakeholder groups) means in reality a further expansion of criteria and principles for existing certification systems. This means that feasibility of biomass certification systems (based on a more extended list of criteria) with respect to controllability and costs are at this point largely unknown.

Figure 4: Making use of existing certification system



Acceptance of existing certification systems (see figure 4), although not covering 100% of the proposed criteria to secure sustainable biomass, may facilitate in the development of an international biomass certification system, at least in the short term. This requires a certain level of flexibility in a transition period of a certification system. This practice is already used by voluntary certification systems (approach 2, 3) as GGL and Electrabel. Currently, knowledge is built up in development of policy instruments; certification systems and pilot projects. This may provide (new) initiators in this field with insights in the development of a certification system.

6.1.5 Scope of possible regulation (legitimacy)

A biomass certification system has to comply with international trade regulations. This in itself requires coherence and coordination of the development of standards and policies from national to international level (approach 4,5). Regulation for a limited number of criteria (energy use, emissions, GHG balance) seems to be possible according to WTO requirements, in section 4.1. This seems to be more complicated for other criteria to secure sustainable biomass (e.g. socio-economic criteria, harvesting methods). It is possible to try to reach international consensus on these criteria, however this is considered to be complicated for criteria with an impact on local scale. In this case, a possible solution is to translate criteria to voluntary standards. With this respect, a private label with higher standards than those mandated by law (approach 3) can be a solution. In general it is desirable for a sustainable biomass standard to be internationally regulated, because this requires acceptance of such standards under international law.

Using international environmental agreements, however, also involves problems. The standards agreed upon are unlikely to be ambitious and international agreements and full implementation by contracting parties can take a long time. Also, MEA are often inadequately implemented due to a combination of factors and problems (limited jurisprudence, soft commitments). An international agreement (approach 4,5) will therefore have to be pursued over a longer period. With the need to secure the sustainability of biomass in a fast growing market, the initial development of a biomass certification system on national / regional level (approach 1,2,3,4), possibly expanded an agreement on international standards (approach 5) on a longer term, seems to be more feasible.

In addition to the establishment of a biomass certification system, there is the possibility for governments to use financial incentives (e.g. subsidies) to stimulate the use of certified biomass (approach 1,3,4), e.g. subsidies are only given to producers that receive a certificate or label. In this case, it is important that the subsidies provided do comply with WTO rules (see 4.1). For the longer term, WTO pursues harmonization of subsidies, which might be a reason for government to select alternative policy measures (legislation) on the longer term to stimulate compliance of sustainable biomass criteria.

6.1.6 Compliance national legislation

It is expected that progress to develop national policies and standards to secure sustainable biomass will vary strongly from country to country. Also national legislation (often required for certification systems) is not always in place or enforcement is weak (see also 4.2.6). Thus, priorities, problems, government structures and processes used vary in different parts of the world, as well as national legislation.

On one hand, these differences require to look at existing governance structures and to refine standards with respect to a regional scope (approach 1,2,3,4). On the other hand, it might be desired to develop a set of minimum international standards to pursue countries to reach a certain level of sustainability for biomass production (approach 5). In all cases, additional support may be needed to improve a country's governance system in general.

6.1.7 Level of comprehensiveness and international coherence

There is a risk for proliferation of criteria and standards that differ from one country or region to another (see 4.2.3). This trend is already visible today. Although most stakeholders preparing criteria agree that these should include environmental and socio-economic aspects, there are already substantial differences in their coherence and how to translate them into indicators and verifiers. For example, table 3 shows differences in the extent and strictness of sustainability

criteria between various NGOs. Existing biomass certification systems (table 7) have not included (at this time) social and economic criteria or only to a limited extent and their environmental criteria are also more limited than those proposed by e.g. various NGOs.

A proliferation of certification systems in the market can create systems from variable quality and involves a risk for high costs for producers, losing commitment from stakeholders and the risk that the system becomes a trade barrier in itself. To prevent this, international coherence between certification systems is desired. From a policy perspective, the preferred situation is one in which countries can agree on common standards. This can be reached by an international framework of standards facilitated by a voluntary agreement by front running countries (approach 4) or by a binding international agreement (approach 5). For both approaches, The Code of Good Practice may serve as a useful instrument to encourage transparency, coherence and further international standardization of a biomass certification system.

6.1.9 Limited time horizon for implementation

A comprehensive, reliable and controllable biomass certification system is most efficient to secure the sustainability of biomass. This can be best achieved through a certain form of regulation (approach 1,5) and international coherence (approach 5). However, achieving this requires a long process of negotiating towards an international treaty (approach 5), which can take a very long time. The question is whether other options are available in the interim. It is expected that the establishment of a voluntary biomass certification system, with its limitations to secure the sustainability of biomass, can be established in only a couple of years (approach 2,4)

6.1.10 Avoiding the creation of additional trade barriers

A voluntary certification system (approach 2, 3) diminishes the risk for possible additional trade barriers as standards have fewer implications for trade compared to regulations. A (combination of) limited number of mandatory regulations (approach 3), or (extended with) a set of standards established by government or a private institution (approach 2,4) is a possibility for a biomass certification system. Concerns related to the impacts of a biomass certification system in developing countries (especially for small stakeholders) relate to stakeholder involvement (6.1.1), regional flexibility (6.1.3 and 6.1.6) and additional support. The last is further discussed in section 6.2.

6.2 Role stakeholders in development of international biomass certification system

Current initiatives on biomass certification from various stakeholder groups range from building up experience through research and pilot studies, further developing sustainability criteria and certification systems and providing assistance. When discussing assistance, the role of developing countries in the development of a biomass certification system requires specific attention. Stakeholders recognize the opportunities of bio energy for developing countries, but express at the same time their concerns. In various cases certification may not be achievable without outside assistance. Based on previous sections, table 10 provides an overview of possible roles of stakeholder groups in the development of biomass certification.

Table 10: Overview of possible roles stakeholder groups in development of biomass certification:

Stakeholders	Possible roles
International bodies	• Assist in development international framework conditions or agreement for bio energy • Initiator debate about role WTO in biomass certification • Coordinating role in stakeholder debate from various stakeholder groups • Support to promote sustainable biomass (financially, building up expertise, sharing knowledge) • Provide specific assistance to developing countries[40]
Regional bodies	• Policy or legal framework on biomass certification on regional level, integrating standards certification system into regional policy • Promoting coherence national policies on regional level • Refinement standards to local and regional conditions, further specification of set biomass standards • Support to build up expertise in implementing biomass certification system • Provide specific assistance to developing countries[36]
Government bodies	• Policy framework for biomass certification, set of biomass minimum standards possibly with more extended set of private standards • Policy measures (subsidies, regulations) to promote sustainable biomass • Support to build up expertise in implementing biomass certification system • Provide specific assistance to developing countries[36]
Companies	Key activities with the focus of initiatives depending on interests of the company: • Build experience in certification through (pilot) studies over the complete biomass chain, gradual learning and expansion of system over time • Promoting cooperation between companies on development certification system • Technical improvements of biomass related products • Financial assistance (especially for banking sector)
NGOs	• Keep watch over the reliability of the system in development • Representing and involving the less powerful in discussion on biomass certification • Building up experience through pilot studies and work in the field, mainly on the biomass production side • Trigger the discussion proposals by the development of principles and pathways for implementation of a biomass certification system.
Roundtables	• Facilitate discussions on biomass certification among stakeholder groups, at this time mainly on biomass production side • Promote initiatives on biomass certification (via biomass production side) in coordination with other initiators on biomass certification systems • Implementation of pilot studies

The implementation of an international biomass certification system involves a wide range of parties and requires therefore good coordination and coherence within and between stakeholders. Recommendations for further cooperation within and between various groups of stakeholders are:

- Companies, especially larger ones, presented in the complete bio-energy chain may play a leading role in knowledge exchange and coordination of initiatives. E.g. energy companies in Europe are pro-active in the development of biomass certification systems. Good coordination between them may stimulate further coherence in the development of these systems, at least on regional level, and form a strong incentive to other producers and companies in the world.
- Cooperation between companies and NGOs in specific elements of the chain, especially on the biomass production side, might be supplementing.
- A strong coordination point in the wide range of initiatives is desired to prevent overlap of activities and to promote coordination and participation of various stakeholder groups in the

[40] Assistance from international, national governments and EC can be provided in various forms. Based on own expertise, assistance can be provided in e.g. integrating sustainability standards for biomass into national or regional policy, development of policy measures, strengthening of national legislation and its enforcement. It is desired to embed specific assistance to developing countries on sustainable biomass in broader national or regional development programs in which wider development issues (e.g. poverty alleviation, energy security) are addressed.

discussion on biomass certification. Beside this, it should be carefully looked at that all relevant stakeholders (also the less powerful) are involved.
- There are a range of international initiatives with, partly overlapping, activities and objectives. A stronger focus per initiative, based on own strengths, is recommended. Based on this, the most appropriate international body or initiative may take the lead in facilitating and promoting an international standardization or agreement for sustainable biomass standards

7. Conclusions and recommendations

Among various stakeholder groups, there seems to be a general agreement that it is important to include economic, social and environmental criteria. Fulfilling these criteria through compliance of criteria defined in a certification system will be, based on current information and status, largely based on standards. Governments may further promote the use of sustainable biomass can be promoted by various policy measures as regulations (though limited) or subsidies. An international agreement on the sustainability of biomass may require more time.

It is expected that a voluntary biomass certification system can be established in only a couple of years. However, at this moment there is limited experience for some criteria to make them operational and more experience is required. As there is a need to secure the sustainability of biomass in a fast growing market, a gradual development of a certification system with gradual learning and expansion over time seems to be most desirable.

The progress made to achieve a system that can secure sustainable biomass trade depends largely on the commitment of companies, governments, international organizations and NGOs active in the biomass production chain. Different stakeholders have different interests and sustainability will play a different role for each of the parties involved: For some countries, especially developing countries, access of sustainable energy for the poor is of high priority. Domestic bio-energy production can be part of the solution. Countries might see a rising demand for export of biomass for feedstock, combined with possibilities to contribute to domestic energy access.
It must be taken into account that a certification system cannot fully guarantee of sustainable biomass trade through a certification system, covering the desired set of social, economic and environmental criteria, at least not for the short or medium term. Therefore, it can be recommended to combine biomass certification, as a tool to (better) secure sustainable biomass, with other policy measures as multi land-use planning or regional prioritization.

Finally, at this moment there are still many uncertainties on the feasibility, implementation and costs for international biomass certification. Gradual learning through pilot studies and research can further improve the feasibility and reliability of a biomass certification system. Besides, more general concerns related to biomass certification as trade barriers or competition with local food and energy supply need to be discussed with a wider public to reach common agreement.

8. Acknowledgements

The authors would like to thank, N. Andre (SGS), B. Bramble (National Wildlife Federation), D. Dijk (Rabobank), J. Douglas (Solidaridad), K. Ernest (UNEP), B. Hektor (TallOil AB), J. Maris (Control Union Certifications), P. Meekers (BIOX), M. Pellan and E. Wijkström (WTO), J. Woods (Imperial College London), and others for their time and input.

A. Faaij (2006). IEA Bioenergy Task 40 - Sustainable International Bioenergy Trade: Securing Supply and Demand. Bauen and R. Tipper (2005). Feasibility study on certification for a Renewable Transport Fuel Obligation, final report, E4Tech, Imperial College London, ECCM: 80.
BioX. (2006). "BioX and Sustainability." Retrieved 27 September 2006.
Birdlife-International (2005). Bioenergy-fuel for the future A Birdlife International Position paper on Bioenergy use in the EU.
BothEnds (2006). Workshop on Dutch import of biomass - producing countries' point of view on the sustainability of biomass exports, Amsterdam.
Bramble (2006). Compilation of Issues to be Addressed in Future Principles and Criteria for Sustainable Biofuels. Washington DC, National Wildlife Federation.
CARGILL. (2006). "Introduction on CARGILL B.V., www.cargill.com." Retrieved 18 September 2006.
Clini and A. Bauen (2005). Global Bioenergy Partnership - White Paper. Territory.
Control-Union (2006). Cramer Project report, version August 2006, Control Union Certifications, UK.
Control Union (2006). Green Gold Label certification programme, Control Union World Group.
Cramer and E. Wissema (2006). Criteria for sustainable biomass production Netherlands, Projectgroep Duurzame Productie van Biomassa.
DaimlerChrysler. (2006). "DaimlerChrysler and UNEP agree on Further Collaboration for Sustainable Mobility, February 23." Retrieved 18 September 2006.
Department for Transport (2006). UK report to the European Commission on biofuels 2006: 14.
E.U. Center. (2006). "Invitation to tender on 'Sustainability criteria and certification systems for biomass production', 2006/S 147-157932." Retrieved 5 September 2006.
EC (2005). Communication from the Commission - Biomass Action Plan, COM (2005)628 final. Brussels: 47.
EC (2006). Communication from the Commission: An EU strategy for Biofuels, COM(2006)34 final. Brussels: 28.
ECP. (2006). "Environmental Choice Program, Products and Criteria."
Electrabel (2006). Wood pellets supplier declaration version 2006.1 Electrabel. version 2006.1.
Ernest (2006). Personal communication for update on current initiatives UNEP in the field of biomass certification from September 2006. Paris: via e-mail with K. Ernest, Programme Officer Transport, Division of Technology, Industry and Economics, UNEP.
ETAP. (2006). "News announcement 'Italy leads the G8 to conclude the Global Bioenergy Partnership', http://ec.europa.eu/environment/etap/pdfs/july06_global_bioenergy_partnership.pdf#search=%22GBEP%20G8%22."
Faaij and M. Junginger (2006). Opportunities and barriers for sustainable international bio-energy trade: towards a strategic advice of IEA task 40. Utrecht, Copernicus Institute for Sustainable Development and Innovation, Department of Science and Technology, Utrecht University and IEA Task 40 members and affiliated parties.
FAO (2006). Introducing the International Bioenergy Platform (IBEP). Rome, FAO.
FASE-ES (2003). Where the trees are a desert - Stories from the ground. Amsterdam.
FFCS (2006). Data on Finnish Forest Certification.
Fresco and Dijk (2006). Biomass for food or fuel: Is there a dilemma? The Duisenberg Lecture, Singapore.
Fritsche and K. Hunecke (2006a). Sustainability standards for bio energy. Darmstadt, Oko institut, commissioned by WWF Germany.
Fritsche and K. Hunecke (2006b). Sustainability standards for bio energy. Darmstadt, Oko institut, commissioned by WWF Germany.
FSC AC. (2003). "Forestry Stewardship Council - because forests matter, http://www.fsc.org/en/." Retrieved 10 September 2006, 2006.
Gehua and Z. Lixin (2006). Liquid Biofuels for Transportation: Chinese Potential and Implications for Sustainable Agriculture and Energy in the 21st Century, Assessment Study. Beijing, Gesellschaft für technische Zusammenarbeit, Chinese Academy of Agricultural Engineering, Institute of Nuclear and New Energy Technology and others.

GGL (2005). GGLS1 – Chain of Custody and Processing, Green Gold Label Program version 2005.5, Control Union World Group.
Governo Federal. (2006). "Biodiesel, the new fuel from Brazil - National biodiesel production and use program." Retrieved 16 October 2006, 2006.
Hektor (2006). Personal communication on the limitations and possibilities on certification for international biomass trade. 40.
Hodson (2006). EU policies for biofuels, DG Tren. The way forward to Sustainable Bioenergies, Brussels.
Howse and P. van Bork (2006). WTO Disciplines and Biofuels: Opportunities and Constraints in the creation of a Global Marketplace, IPC Discussion Paper. Washington DC, International Food and Agricultural Trade Policy Council: 44.
Junginger, de Wit and Faaij (2006). Country report for the Netherlands - update 2006, IEA Bioenergy task 40. Utrecht, the Netherlands, Copernicus Institute - Department of Science, Technology and Society, p. 31.
Kashyap and others (2005). Liquid biofuels for transportation: India country study on potential and implications
for sustainable agriculture and energy, The Energy and Resources Institute, German Technical Cooperation.
Kleinschmidt (2006). IATP Sustainable biomass production principles and practices. Minneapolis, USA, Rural Communities Program, Institute for Agriculture and Trade Policy.
Lange and others (2006). Dutch import of biomass - producing countries' point of view on the sustainability of biomass exports. CREM report number 06.885. Amsterdam, Both ENDS, Stichting Natuur en Milieu, COS Nederland, Núcleo Amigos da Terra (NAT), Vitae Civilis Institute, Biodiversity Foundation Kehati, Sawit Watch, Social Economic Institute (INRISE), Bogor Agricultural University, Media Indonesia Group-Daily Research and Development, Ms Gwynne Foster CREM BV,.
Lewandowski and Faaij (2005). "Steps towards the development of a certification system for sustainable bio-energy trade." Biomass & Bioenergy 30: 83-106.
Maier and G. Knauf (2005). Global market for bio energy between Climate protection and Development policy, NGO policy paper. G. Maier. Bonn, German NGO Forum on Environment and Development.
Marchal and Rijckmans (2006). Efficient trading of biomass fuels and analysis of fuel supply chains and business models for market actors by networking, country report Belgium, IEA Task 40. Current situation and future trends in biomass fuel trade in Europe, EUBIONET II, CRAGx, Loborelec.
Maris (2006). Personal communication with J. Maris, Control Unions, about status GGL system and possible implications for the implementation of a biomass certification system.
Martines-Filhao and H.L. Burnquist (2006). "Bioenergy and the rise of sugarcane based ethanol in Brazil." Choices, a publication of the American Agricultural Economics Association, JEL Classification: Q42,054,013 2(21): 91-96.
Moret and D. Rodriques (2006). Sustainability criteria and indicators for bio energy, FBOMS, Energy working group of the Brazilian Forum of NGOs and Social Movements for the Environment and Development.
Mortished (2006). Food prices would soar in biofuels switch, says Unilever. Time newspapers Ltd.
NRC (2005). Forest industry seeks EcoLogoM certification for biomass cogeneration Heads Up Newsletter. IX.
Oehme (2006). Development of ecological standards for biomass in the framework of green electricity labelling, WP2.2 report from the CLEAN-E project, Clean Energy Network for Europe, IFZ: 64.
Ortiz (2006). Personal communication with L. Ortiz from Friends of the Earth Brazil during meeting to discuss current initiatives on sustainability criteria for biomass. Utrecht: Meeting organized by Solidaridad on 16-10-2006.
PEFC. (2006). "Introduction on PEFC, http://www.pefc.org/internet/html/links.htm." September 2006.

Prins (2007). Personal communication e-mail with K. Prins, Project officer DG TREN, European Commission. Brussels.
ProForest (2004). The Basel Criteria for responsible soy production. Oxford, Proforest for Coop Switzerland in cooperation with WWF Switzerland.
ProForest (May 2006). Developing a mechanism for palm oil traceability from plantation to end user, annex 6 Draft chain of custody procedures for pilot testing. Oxford, Proforest commended by RSPO.
Richert and S. Sielhorst (2006). Betere Biomassa - Achtergronddocument en principes voor duurzame biomassa (commisioned by WWF, Natuur en Milieu, IUCN Nederland). Amsterdam, AIDEnvironment.
Rose (2006). FAO activities on biomass certification in cooperation with IEA Task 31. Rome: Forestry officer Forest Products and Economics Devision FAO.
RSPO (2005). RSPO Principles and Criteria for Sustainable Palm Oil Production, RSPO.
RSPO (2006). RSPO Draft Verification Systems, public consultation draft.
RTRS (2006). Objectives and background of the Roundtable on Responsible Soy http://www.responsiblesoy.org/eng/index.htm.
Several (2004). Declaracion de Bonn, Organizaciones Ciudadanas de America Latina en Bonn. International Conference on Renewable Energy, Bonn.
Smeets and I. Lewandowski (2005). The impact sustainability criteria on the costs and potentials of bio energy production. An exploration of the impact of the implementation of sustainability criteria on the costs and potential of bio energy production applied for case studies in Brazil and Ukraine. Utrecht, the Netherlands, Utrecht University.
Smeets and M. Junginger (2006). Sustainability of Brazilian bio-ethanol. Utrecht, Copernicus Institute (Utrecht University), UNICAMP.
Solidaridad (2006). Annex A: Contribution to policy document Essent-WNF-SNM-Solidaridad, concerning pilot project coffee husks from Brazil.
Stam (2006). A fast changing environment, opportunity or threat - CEFETRA B.V. Strategical brainstorm session project group 'Sustainable Production of Biomass', September 13 2006.
Sugrue and others (2006). Towards a Southern African NGO Position on Biofuels, CURES Southern Africa.
Swaan (2006). Presentation on BioEnergyOpportunities 2006, Technology Trade Mission. Follow-upWorkshop “Wood pellets”.
UN-Energy (2006). Energy in the United Nations: An overview of UN-Energy activities: 52.
UNCTAD. (2006). "Preliminary Annotated Agenda of Day Two (30 November 2006): Biofuels, expert Meeting on Participation of Developing Countries in New Dynamic Sectors of World Trade: Review of the Energy Sector adjusting to the New Energy Economy."
UNF. (2006). "Factsheet: the United Nations Biofuels Initiative, http://www.unfoundation.org/files/2006/biofuels_factsheet.pdf."
Unilever (2006). Biofuels Unilever Position Statement.
Fritsche, U.R. (2006). Sustainability standards for bio energy. Darmstadt, Oko institut, commissioned by WWF Germany.
Vaals (2006). Biofuels: Growing pains... Strategical brainstorm session project group 'Sustainable Production of Biomass', September 13 2006, Rabobank, Food and Agribusiness Research and Advisory.
Verdonk (2006). Governance of the Emerging bio-energy markets. Copernicus Institute for Sustainable Development and Innovation. Utrecht, Utrecht University.
Verhaegen and L. Meeus (2005). Towards an international certificate system - the stimulating example of Belgium. Annual Global Conference on Environmental Taxation, University Leuven, Belgium.
Verweij and Maarek (2006). Biomassa: Risico's en Kansen. Amsterdam, AID Environment, commissioned by Milieudefensie, BothEnds, WWF, Greenpeach, Natuur en Milieu, Oxfam Novib.
Volkswagen. (2006). "Volkswagen calls for preferential status for second-generation biofuels, press release." Retrieved 7 September 2006.
Volpi (2006). Soya is not the solution to climate change The Guardian. London.

Voss (2004). Shell's interest in biomass for biofuels. BUS meeting 7 September 2004, The Hague, Shell Global Solutions.
Walter and P. Dolzan (2006). Biomass Energy and Bio-energy Trade: Historic Developments in Brazil and current opportunities. Country Report Brazil. 40.
Wessels and others (2001). Ecolabelling and international trade law implications. Product certification and ecoloabelling for fisheries sustainability. Rome, FAO Fisheries Technical Paper 422.
Wijkstrom (2006). Personal communication via phone with counsellor Trade and Environment Division, World Trade Organization. Geneva.
WTO. (2006a). "Agriculture Negotiations, Backgrounder, Phase 1: Domestic support — amber, blue and green boxes ".
WTO. (2006b). "CTE on: how environmental taxes and other requirements fit in, http://www.wto.org/english/tratop_e/envir_e/cte03_e.htm." Retrieved 27 September 2006.
WWF. (2006a). "Better Sugarcane Initiative (BSI), www.panda.org/agriculture/bettersugarcane " Retrieved 13 November 2006, 2006.
WWF (2006b). WWF Position on Biofuels in the EU. Brussels, WWF European Policy Office.
WWI (2006). Biofuels for transportation - global potential and implications for sustainable agriculture and energy in the 21st century. Washington D.C., Worldwatch Institute, commissioned by German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) in cooperation with the Agency for Technical Cooperation (GTZ) and the Agency of Renewable Resources (FNR).
Zarrilli (2006). The emerging biofuels market: regulatory, trade and development implications. Geneva, United Nations Conference on Trade and Development (UNCTAD).

Appendix IV: Recent Developments in the Biofuel Industry [Tekst uit WWI, 2007 en UNCTAD, 2006]

The recent proliferation of biofuel programs around the world can be attributed to a combination of factors. Countries that wish seek to bolster their agricultural industries (long the main driver of biofuel programs) have been joined by an increasing number of nations that are concerned about such factors as high oil prices, political instability in oil-exporting countries, climate-altering greenhouse gas emissions, and urban air pollution. Continuing developments in biorefining technology have also brought greater attention to biofuels as a potentially large-scale and environmentally sustainable fuel.

A diverse range of countries around the world has recently sought new ways to promote use of biofuels. For example:

- In *Japan*, the government has permitted low-level ethanol blends in preparation for a possible blending mandate, with the long-term intention of replacing 20 percent of the nation's oil demand with biofuels or gas-to-liquid (GTL) fuels by 2030.

- In *Canada*, the government wants 45 percent of the country's gasoline consumption to contain 10 percent ethanol by 2010. Ontario will be the centre of the ethanol program, where the government expects all fuel to be a 5 percent blend of ethanol by 2007.

- A *European Union* directive, prompted largely by the requirements of the Kyoto Protocol, has set the goal of obtaining 5.75 percent of transportation fuel needs from biofuels by 2010 in all member states. In February 2006, the EU adopted an ambitious Strategy for Biofuels with a range of potential market-based, legislative, and research measures to increase the production and use of biofuels. *France*, in particular, has announced plans to rapidly expand both ethanol and biodiesel production, with the aim of reaching the EU targets before the deadline.

- In the *United States*, high oil prices and agricultural lobbying prompted the recently enacted Renewable Fuels Standard (RFS), which will require the use of 28.4 billion litres (7.5 billion gallons) of biofuels for transportation in the country by 2012. Many U.S. government fleet vehicles that run on diesel fuel are now required to use B20 blends under new guidelines implementing the Energy Policy Act of 1992. Many in the industry believe that these targets represent a floor, rather than a limit, to biofuel production.

- In *Brazil*, the government hopes to build on the success of the Proalcool ethanol program by expanding the production of biodiesel. All diesel fuel must contain 2 percent biodiesel by 2008, increasing to 5 percent by 2013, and the government hopes to ensure that poor farmers in the north and northeast receive much of the economic benefits of biodiesel production

- Elsewhere in Latin America, as of 2006, *Columbia* will be mandating the use of 10 percent ethanol in all gasoline sold in cities with populations over 500,000. In *Venezuela*, the state oil company is supporting the construction of 15 sugar cane distilleries over the next five years, as the government phases in a national E10 blending mandate. In *Bolivia*, 15 distilleries are being constructed, and the government is considering authorizing blends of E25. *Costa Rica* and *Guatemal*a are also in the trial stages for expanding production of sugar cane fuel ethanol. *Argentina*, *Mexico*, *Paraguay*, and *Peru* are all considering new biofuel programs as well. As the world's leader in fuel ethanol, Brazil has helped many of these countries learn from its example. (See Sidebar 1–1.)

- In Southeast Asia, *Thailand*, eager to reduce the cost of oil imports while supporting domestic sugar and cassava growers, has mandated an ambitious 10 percent ethanol mix in gasoline starting in 2007. For similar reasons, the *Philippines* will soon mandate 2

percent biodiesel to support coconut growers, and 5 percent ethanol, likely beginning in 2007. In *Malaysia* and *Indonesia*, the palm oil industries plan to supply an increasing proportion of the countries' diesel.

- Chinese and Indian planners have also sought to expand the national supply of ethanol and biodiesel. In *India*, a rejuvenated sugar ethanol program calls for E5 blends throughout most of the country, a level the government plans eventually to raise to E10 and then E20. In *China*, the government is making E10 blends mandatory in five provinces that account for 16 percent of the nation's passenger cars.

- In Africa, efforts to expand biofuels production and use are being initiated or are underway in numerous countries, including Kenya, Malawi, Zimbabwe, Ghana, Ethiopia, Benin, Mozambique, Senegal, Guinea Bissau, Ethiopia, Nigeria, and South Africa.

Biofuels promise new and dynamic export flows of both raw materials and finished products. Today global trade in biofuels, however, remains fairly small relative to both biofuel demand and traditional fossil fuels trade. In 2004, international trade of ethanol was around 3 billion litres, as opposed to around 920 billion litres of international trade in crude oil.

As illustrated, international trade in ethanol underwent a strong expansion, from very limited exports in 2000 led by the United States and the EU, to a dynamic market in 2004 largely dominated by Brazil. Brazil has about 50 percent market share of global ethanol exports, with India and the United States as main export markets.

The cane sugar exports pattern does not show any trade increase over the period 2000- 2004. As trade in cane sugar does not seem to be affected by the surge in ethanol production, one can assume that sugar is not traded for the purpose of ethanol production. Several factors may contribute to this situation: ethanol production from sugar is a rather widely known and cheap process that can be easily replicated; the cost of transport of raw sugar, as compared to that of equivalent ethanol, makes it disadvantageous. The other main feedstock used to produce ethanol is maize. As it is the case for sugar cane, the surge of ethanol production does not seem to have had any relevant impact on world trade of maize. This may also be due to the fact that the top maize world producer - the United States - is also a large ethanol consumer and this limits the scope for maize exports. As international trade in feedstocks does not seem to evolve along the path of growing ethanol demand, it can be assumed that producing countries are for the time being relying on domestically produced feedstocks for ethanol manufacturing.

Biodiesel
The international market of biodiesel is in its infancy, therefore no reliable trade statistics are available. Biodiesel has recently been re-classified by the World Customs Organization under the HS code 3824 90 – an industrial code which includes a large spectrum of chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products) not elsewhere specified or included. It is, therefore difficult to identify trade flows, trends and opportunities specific to biodiesel. Trade in biodiesel feedstocks, however, has experienced significant growth that may be partly attributed to the rising demand for biodiesel.

Exports of palm oil and soybean oil have registered a sharp increase since 2000. Main importers of soybean include several Asian developing countries that use it for food purposes. Therefore, the surge in soybean exports does not seem to be linked to biodiesel production.

The pattern is different for international trade in palm oil, which is the second most traded oil worldwide. The diet of developing countries, but not developed countries, includes palm oil. There are flows of palm oil from Indonesia and Malaysia to developing countries like India, Bangladesh, Kenya and Mexico on the one hand, and to developed countries like Germany, the Netherlands and the United Kingdom on the other hand. While it is hard to assess which percentage of palm

oil is used as food and which percentage is used as energy feedstock, it can be assumed that part of the recent palm oil import surge into the EU has been used for biodiesel production.

Trade flows seem to indicate that feedstocks are traded internationally and that oil processing into biodiesel takes place in countries different from those which produce the feedstocks, as opposed to bioethanol which is manufactured where its feedstocks are cultivated. One possible explanation is that biodiesel until now has been produced almost exclusively in the EU which owns the technology and know-how related to biodiesel processing. Additional considerations related to logistics may also play a role. Trade of edible oils concerns crude oil, while the process of refining is usually carried out in the importing countries. A limited number of large firms control the refining process. The transport, storage and other facilities which are used for trading crude edible oils may then be used for trading biodiesel feedstocks.

The EU trade regime
As far as specific countries' trade performances and tariff regimes, the EU imported more than 2.5 million hectolitres of ethanol during the period 2002-2004. About 30 percent of this volume was imported as normal MFN trade and subject to specific import duties of Euro 10.2/hectoliter on denatured alcohol (HS 2207 20) and Euro 19.2/hectoliter on undenatured 26 alcohol (HS 2207 10). Brazil is the largest ethanol exporter to the EU with all of its exports made as MFN. During the 2002-04 period, 25 percent of EU ethanol imports were from Brazil. The remaining 70 percent of EU alcohol imports entered under preferential trade arrangements (61 percent entered duty free and 9 percent at reduced duty), including the
Generalized System of Preferences (GSP, applying to many developing countries), the Cotonou Agreement (for ACP countries), the Everything But Arms (EBA) Initiative (for LDCs), amongst others. Pakistan, with a 20 percent share of EU ethanol imports, was the largest exporter under preferential trade arrangements. Other ethanol exporting countries that benefited from EU trade preferences included Guatemala, Peru, Bolivia, Ecuador, Nicaragua, and Panama (which benefited from unlimited duty-free access accorded under special drug diversion programs); Ukraine and South Africa (under the GSP); the Democratic Republic of Congo (under EBA); Swaziland and Zimbabwe (as ACP countries); Egypt (under the Euro- Mediterranean Agreement); and Norway (under special quota).
The new GSP Regulation - which applies from 1 January 2006 to 31 December 2008 - no longer provides for any tariff reduction for either denatured or undenatured alcohol. However, the Regulation includes an incentive scheme for sustainable development and good governance. The scheme provides unlimited and duty-free access to denatured and undenatured alcohol. All countries that already benefited from the previous drug scheme, plus Georgia, Sri Lanka, Mongolia and Moldova, are included in the incentive programme. Pakistan, one of the most competitive ethanol producer, is excluded however. Duty-free and quota-free access is granted to the LDCs under the EBA Initiative. While exports of ethanol from EBA countries have so far been negligible, new opportunities may emerge in those countries, particularly as a result of increased sugar cane cultivation. In recent years, several LDCs have received massive foreign investment in sugar cane.

Under the Cotonou Agreement, ACP countries qualify for duty-free access for both denatured and undenatured alcohol. However, South Africa, which exported approximately 50,000 hectolitres per year to the EU market over the 2002-2004 period, has to pay full MFN duty. As in other sectors, export performance is often penalized by the graduation of the successful countries from the preferential schemes.
EU imports of biodiesel are subject to an *ad valorem* duty of 6.5 percent. Since biodiesel production outside of the EU is still limited, there has been no significant external trade, while there has been considerable intra-European trade. Recent heavy investments in a number of developed (e.g. Australia and United States) and developing countries (e.g. Brazil, India, Indonesia, Malaysia) indicate that these countries are in the process of becoming producers and possibly exporters of biodiesel. 64 International trade of raw materials is growing. To relax pressure on rapeseed oil production, European biodiesel producers have begun sourcing feedstocks from foreign sources. Since 1999, EU imports of palm oil (primarily from Malaysia)

have more than doubled to 4.5 million tonnes in 2005 (representing 18 percent of world palm oil imports).

The US trade regime

In 2005, the United States imported 680 million litres of ethanol, representing 5 percent of domestic consumption. The United States imposes MFN import duties of $14.27 cent/litre plus a 2.5 percent *ad valorem* tariff on ethanol. In many cases, this tariff regime offsets lower production costs in other countries and represents a significant barrier to imports. A limited amount of ethanol may be imported duty-free under the Caribbean Basin Initiative (CBI)65 even if most of the steps in the production process were completed in other countries. More specifically, if produced from at least 50 percent local feedstocks, ethanol may be imported duty-free into the US market. If the local feedstock content is lower, limitations apply on quantity of duty-free ethanol. Nevertheless, up to 7 percent of the US market may be supplied duty-free by CBI ethanol containing no local feedstocks. In this case, hydrous ethanol produced in other countries (historically Brazil or European countries), can be shipped to a dehydration plant in a CBI country for reprocessing. After the ethanol is dehydrated, it is imported duty free into the United States. Currently, imports of dehydrated ethanol under the CBI are far below the 7 percent cap (approximately 3 percent in 2005), though the situation may change as agribusinesses, some of them North American, are investing in ethanol plants in the Caribbean. Dehydration plants are currently operating in Jamaica, Costa Rica, El Salvador and Trinidad and Tobago.

Duty-free ethanol imports have also played a role during the negotiations of the US Central America Free Trade Agreement (CAFTA)68. However, CAFTA doesn't introduce major changes. It doesn't increase overall preferential access to the U.S. ethanol market but it does establish country-specific shares for El Salvador and Costa Rica within the existing CBI quota. The other CAFTA countries retain existing CBI benefits on ethanol. Duty-free treatment of ethanol in the United States has raised concerns. Critics argue that expansion of duty-free imports from CBI would undermine the domestic US ethanol industry. In particular, preoccupations refer to ethanol produced in Brazil, sent to CBI countries for dehydration, and then exported duty-free to the United States. However, the considerable expansion of the US ethanol market expected in the wake of the 2005 Energy Policy Act should appease domestic ethanol producers' and maize growers' apprehensions. Conversely, others believe that tariffs on imported ethanol should be eliminated to diminish gasoline consumption and mitigate fuel prices increases.

Appendix V: Tekst uit UNCTAD paper: 'WTO Implications'

Zarrilli, S. (2006). The emerging biofuels market: regulatory, trade and development implications. Geneva, United Nations Conference on Trade and Development (UNCTAD). "THE WTO IMPLICATIONS":

Environmental Goods and Services

Paragraph 31 (iii) of the Doha Development Agenda has launched negotiations on "the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services." Negotiations on environmental goods are carried out by the Special Sessions of the Committee on Trade and Environment (CTE) and by the Negotiating Group on Non-Agriculture Market Access (NAMA). Negotiations on environmental services are conducted within the Special Sessions of the Council for Trade in Services. Lacking conclusive progress in the negotiations, the paragraph relating to environmental goods and services included in the 2005 Hong Kong Ministerial Declaration simply instructed Members to "expeditiously complete the work" under paragraph 31(iii).

At present, the environmental goods negotiations continue to remain focused on how to define "environmental goods" and/or criteria to identify them. Several approaches have been proposed, including: (i) establishing a positive list based on, for example, the APEC and/or OECD lists of "environmental goods;" (ii) establishing a list of "environmentally preferable products" (EPP) 69 , although the crucial question of whether environmentally preferable process and production methods (PPMs) are included in the definition remains unsettled; (iii) adopting the environmental project approach (EPA) suggested by India, under which environmental goods and services would be liberalized within the framework of environmental projects undertaken at the national level and approved by national authorities; and (iv) combining the environmental project approach with the list approach (integrated approach), as suggested by Argentina.

It has been proposed that the definition of environmental goods covers, *inter alia*, renewable energy products, including ethanol and biodiesel and related products. Improved market access for products derived from or incorporating cleaner technologies, such as "flexi fuel" engines and vehicles, could also be pursued. 71 Moreover, parts and components of biodiesel and bioethanol plants could be classified as environmental goods. It should be noticed, however, that while biodiesel is classified as an industrial product under the HS code 382490, ethanol is classified as an agriculture products under the HS code 2207. The Negotiating Group on Non-Agricultural Market Access is working on modalities for tariff reductions. However, some difficulties may emerge when the Group tackles an agriculture product, such as ethanol. The Negotiating Group on Agriculture may therefore provide an alternative forum for ethanol negotiations, as well as for other agricultural products which may be identified as environmental goods.

By using the above-mentioned criteria, the list of goods to be potentially regarded as environmental goods has become extremely large (around 480 products). This has caused WTO members to now consider two sets of "indicative parameters" for screening the products included in the lists. Additional considerations - such as transfer of technology, special and differential treatment, and the achievement of win-win-win results - could also be used to streamline the lists.

Many disagreements among countries on the identification of environmental goods, on the scope and approach to take to liberalize trade in such products, and on mechanisms for regularly updating the product list to account for constantly moving targets, are hampering any conclusive result. Moreover, the interaction between the CTE's work and that of the NAMA Negotiating Group is unclear. It is yet to be decided whether environmental goods, if and when identified, will profit from special tariff reductions or whether they will benefit from the tariff reductions of other products under the mandate of the NAMA Negotiating Group. Countries may look increasingly to bilateral and regional agreements as quicker and more predictable tools for the removal of tariffs and non-tariff measures affecting international trade in biofuels and related technologies.

Moving to environmental services72, while developing countries are by and large net importers of environmental services, biofuels is an area where some of them have developed expertise and could be in a position to export services. In this field, companies often export integrated packages of goods, technology and trained personnel.

Export opportunities may emerge especially through Mode 1 (cross-border trade), which is of special relevance for consultancy and other kinds of services which do not require physical presence in the importing country, and through Mode 4 (movement of natural persons). Restrictions on Mode 1 can significantly impact trade in services related to biofuels. For instance, residence may be required in the importing country to supply that country's market on a cross-border basis. Limitations on the movement of natural persons may also affect the capacity to export services related to biofuels, since companies may need to bring in specialized professionals.

The entry into force of the Kyoto Protocol in February 2005 may allow a lucrative service sector to develop in relation to the trading of emissions rights. The complexities involved in conducting, monitoring, verifying and enforcing emissions trading schemes and in designing and implementing carbon credit projects allow considerable margin for the market development of various services activities. The early experiments in emissions trading have underlined the key role played by large consulting firms from industrialized countries which are at present benefiting from new business opportunities.

According to GATS Services Sectoral Classification List, consultancy services fall under the general category of "other business services". The question is then whether the consultancy services described above may be classified as environmental/energy services in consideration of their specific use in the biofuels or CDM fields. It is worth to recall that under the GATS classification, services sectors are classified in a mutually exclusive way: services in one sector cannot be covered by another sector. Some WTO Members propose that, in addition to the identification of “core” environmental/energy services, commitments should also include ancillary services such as engineering, R&D and consultancy services.

Labelling and Certification
With an expected considerable increase in trade in feedstocks to allow countries to meet their self-imposed biofuels targets, the sustainability of biomass production is becoming an increasingly important issue and is currently being considered as a requirement for biofuel to access developed country markets.

Concerns related to feedstock production refer to the risk that increasing biofuel demand will lead to the cultivation of previously uncultivated land. This could include land with a high environmental value and/or high level of stored carbon. Under some circumstances, cultivation of land could reduce its environmental value and release CO2 into the atmosphere. The negative effects of such a situation could possibly eclipse the greenhouse gas benefits of biofuels. There may be other cases that the cultivation of biofuel raw materials could jeopardise the environmental advantages of biofuels. Some biofuels deliver more greenhouse gas benefits than others, and some deliver more security of supply benefits than others. Some believe that these characteristics should be properly reflected in a system of certificates.

These considerations have prompted some countries, companies and NGOs to consider developing criteria that energy feedstocks should meet in order to prove their overall sustainability. Certification systems that prove compliance with the criteria would then be developed and compliance with sustainability criteria and related certification requirements may become preconditions for entering certain markets, especially developed markets where consumers may be particularly sensitive to environmental and /or social issues.

While to get sustainability insurance, through labelling and certification, is a legitimate goal, applying these tools to biofuels remains a rather complex issue. Efforts should then be deployed

to ensure that criteria and certification systems contribute to environmental objectives without creating new barriers to international trade, especially to exports from developing countries.

The Dutch government is working on criteria for sustainability assessments of biomass utilization in biofuels production. The EC Commission is conducting a public debate regarding, *inter alia*, the suitability of a certification system to ensure that biofuel raw materials have been cultivated under minimum environmental standards. In addition or alternatively, certificates might be issues to indicate the greenhouse gas and/or security of supply impact of each type of biofuel75. WWF is requesting the EU for obligatory certification of all biofuels used in the EU, whether they come from domestic or imported sources. In WWF's view, the certification system must be based on enhancing the potential of biofuels to cut greenhouse gas emissions while avoiding negative environmental impacts related to biofuel production.

Precedents in the field of sustainability certification exist in the forestry, agriculture and electricity areas. The development of certification systems in forestry was a market based response to address public concerns about tropical deforestation, resulting loss of biodiversity and the perceived low quality of forest management. The introduction of forest certification was led by the Forest Stewardship Council (FSC) and a range of other schemes were operational at the end of the last decade.

For the agricultural sector, different certification systems exist that were implemented to ensure that the products are produced in an environmental sustainable way and are safer or healthier for the consumer. Certification in organic agriculture has the longest history: the first environmental label for organic agriculture was introduced at the European level in 1991.

Certification systems for fair traded agricultural products have also been implemented to ensure ‘fair’ payment of agricultural products, enhance producers' quality of life, improve their market access and reduce their dependency on middlemen.

In the energy sector, a number of green electricity labels exist and some of them include definition and criteria for biomass. Though there are significant differences in the conditions required for biomass, in principle two approaches in defining green electricity from biomass can be found: (i) definition and criteria involving the feedstocks (e.g., qualifying crops, ecological integrity of cultivation) and exclusion of certain technologies (e.g., genetic engineering); (ii) specifications for criteria regarding the processing of the feedstocks at the plant level.

Criteria of existing certification schemes addressing sound resource management and responsible enterprise behaviour are being considered in the development of potential criteria for the sustainable production and trade of energy feedstocks. The existing criteria refer to production sustainability, leakage effects, food and energy supply security, biodiversity conservation, greenhouse gas emissions, water conservation, strength and diversification of local economies, human health and safety, rights of children and indigenous people, adequate quality of life, and labour conditions. It is worthy to note, however, that there is more experience applying some and little or no experience applying others of the abovementioned criteria. Therefore, caution should be used when applying those criteria to the bio energy field.

There are a number of possible problems and grey areas related to certification/labelling of biofuels and/or related feedstocks. To ensure that certification does not become an obstacle to international trade, sustainability criteria should be developed through a transparent and fair process where countries, both producing and consuming, are effectively represented. To this end, support is needed to improve developing country capacity to play an active role in the development of criteria. Criteria and related certification/conformity assessment schemes81 must be easy to apply and flexible enough to take account of local conditions. Measures to ensure conformity can also act as powerful nontariff barriers if they impose costly, time-consuming, and unnecessary tests or duplicative conformity assessment procedures. Developing countries have traditionally encountered difficulties getting certificates issued by their domestic certification

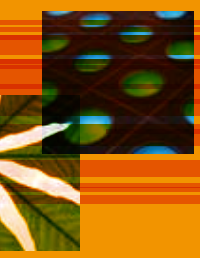
bodies recognized by the importing countries. In most cases they have had to rely on the expensive services provided by international certification companies. If certification/labelling requirements are established, they should be coupled with financing and technical assistance to improve the capacity and credibility of developing country certification bodies while enlarging certification access to medium and small-sized companies.

Moving to WTO rules, the Agreement on Technical Barriers to Trade (TBTAgreement), covers technical regulations and standards, including packaging, marking and labelling requirements, and procedures for conformity assessment. The Code of Good Practice for the Preparation, Adoption and Application of Standards (Annex 3 to the TBT Agreement) refers to the activities carried out by any standardization body, including non-governmental bodies, which develop standards, i.e. rules, guidelines or characteristics for products and related processes and production methods with which compliance is not mandatory. The Code seeks to bring all standards within its purview and provides for transparency in the preparation, adoption and application of standards.

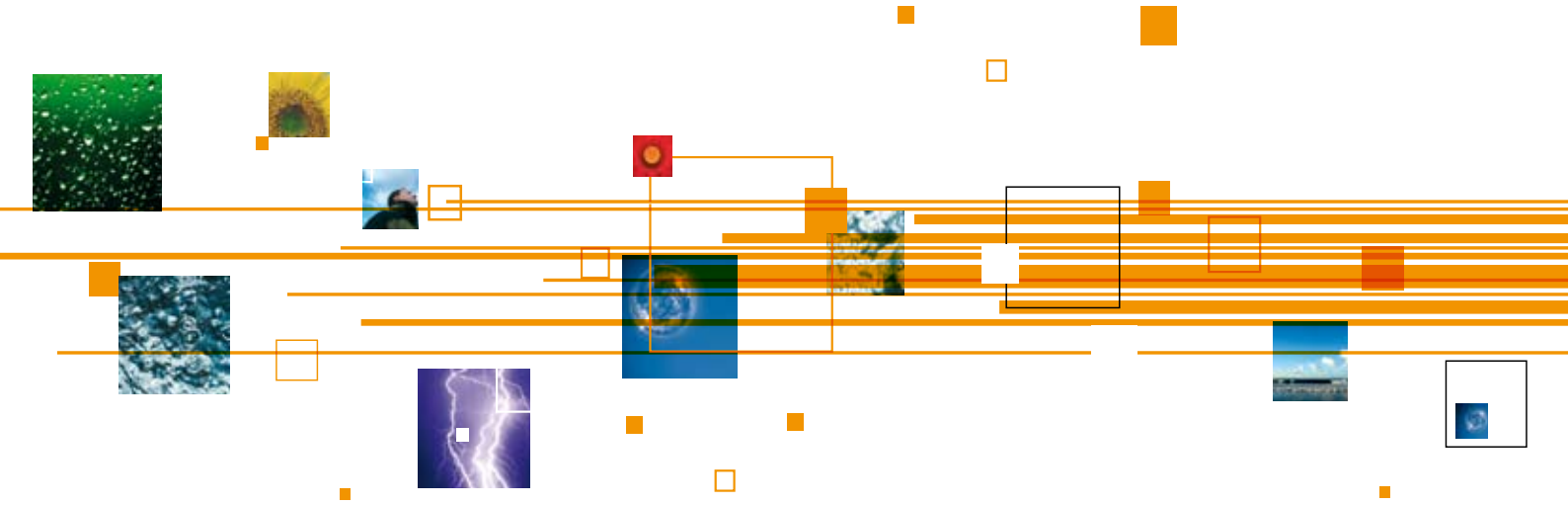
A quite active debate took place in the 1990s regarding the use of the Code of Good Practices, especially with reference to voluntary eco-labelling schemes. The preoccupations which prompted this debate were that eco-labelling schemes, by being voluntary and often developed by private bodies, would, to a large extent, escape from multilaterally agreed trade obligations. Nevertheless, they would have a significant impact on trade flows. WTO Members reached the agreement to make efforts on a voluntary and non-binding basis to maximize the use of the Code of Good Practice for eco-labelling programmes and to apply the notification obligations meant for mandatory measures to voluntary measures, including those developed by non-governmental bodies. A similar solution could apply to certification schemes of biofuel/feedstock, especially voluntary programmes developed by nongovernmental bodies. The main benefit of such a solution is that producers and exporters would be informed in advance of the development of certification/labelling programmes and would have opportunity to provide comments on proposals as well a time to adjust to the new requirements before their implementation.

The “like” products issue
The criteria which are in the process of being developed to distinguish energy feedstock produced according to sustainable practices from the others, raise a fundamental question, namely whether such a distinction between products which share the same physical characteristics is consistent with internationally agreed trade rules. The national treatment principle incorporated into GATT Article III implies non-discrimination between domestic and imported goods. This means that the importing country is not allowed to apply to foreign products measures more onerous than those applied to “like” domestic products. In the context of Article III, the determination of what constitutes “like products” is a crucial issue, since the national treatment obligations apply only if two products are “like”.

In assessing whether products are “like”, the controversial issue is whether the analysis should be limited to the product's physical characteristics or should also take into account the process and production methods. The relevant jurisprudence is not conclusive, and authoritative authors are deeply divided on the subject.82 On the one hand, it has been argued that there is no real support in the text and jurisprudence of the GATT for the product/process distinction 83 and that the distinction is neither warranted nor useful in practice.84 On the other hand, it has been suggested that there is a textual basis in GATT Article III and the Note ad Article III for the product/process distinction and that the distinction should be retained to prevent protectionist abuses. The product/process distinction is therefore an open issue. Jurisprudence related to GATT Article XX (General Exceptions), on the other hand, seems to have evolved to interpret Article XX as covering measures that distinguish products on the basis of the production processes.86 As far as the relationship between Article III and Article XX is concerned, the Appellate Body in the Asbestos case regarded the two articles as complementary and not mutually exclusive. Distinguishing feedstocks on the basis of environmental standards remains then a complex legal issue.





EnergieTransitie - Creatieve Energie

Bedrijfsleven, overheid en maatschappelijke organisaties zetten zich gezamenlijk in om ervoor te zorgen dat de energievoorziening in 2050 duurzaam is. Energie is dan schoon, voor iedereen betaalbaar en wordt continu geleverd. EnergieTransitie vraagt en geeft creatieve energie.

Contactgegevens

EnergieTransitie
Platform Groene Grondstoffen
Postbus 17
6130 AA Sittard

Secretaris: Edith Engelen-Smeets
E-mail: groenegrondstoffen@senternovem.nl
Telefoon: (046) 420 23 51

www.creatieve-energie.nl

Creatieve Energie
EnergieTransitie