PROPOSED IRENA WORK ON BIOENERGY 2018-19

Activities and deliverables under three pillars of effort will largely depend on voluntary contributions. The list of projects may be tailored, and the scope of each adjusted, in response to country interest.

Sustainable resource efforts will focus on communicating how bioenergy is needed to expand *energy access* and *restore degraded land*, can be produced *together with food*, can help achieve *climate goals*, and requires support from development agencies for *scale-up*. Sustainable forest management in developed countries and sustainable farming in developing countries will be highlighted.

Technology pathways assessment will focus on liquid and gaseous biofuels for aviation, shipping and freight applications that are difficult to electrify; on the use of lignocellulosic feedstocks like rapidly growing wood and grass species; on the development of cost-effective supply chains to amass such feedstocks at scale; and on high-value chemicals and materials that can enhance biofuel economics.

Scale-up tools and strategies work will focus on enhancing the *Bioenergy Simulator* to help determine the best mix of food and fuel crops in a given area, on extending the *Project Navigator* to help investors get financing for a broader range of bioenergy projects, on developing regional potentials for farm and forest residues, and on strategies for scaling up bioenergy in member countries upon request.

Sustainable Resources Pillar (SR)

SR-1 Sustainability Outreach to Build Support

IRENA, FAO and IEA Bioenergy have prepared a joint briefing paper on *Bioenergy for Sustainable Development* which explains how bioenergy can help meet sustainable development goals like food and energy security and climate change, but government ministries and civil society remain skeptical. This project will expand outreach to show that food and fuel can go together along with biodiversity and carbon sequestration, with particular focus on development banks and agencies whose financial resources are needed to invest in skills and practices that can boost food yields and reduce food losses in developing countries so that less land is needed for food and more can be used for energy.

SR-2 Logistics of Collecting Sustainable Feedstocks

IRENA has identified huge bioenergy resource potential from the residues of food production on farms and lumber production in forests, but a large portion of these residues are not collected. This project will assess resource logistics practices to assemble large amounts of farm and forest residues which are often considered of too little value to collect, catalogue real-world examples of economic and policy Incentives that can promote residue collection, and explain how biomass depots can process a diverse mix of biomass resources into a storable, homogeneous feedstock that can delivered upon demand.

SR-3 Scaling Up Sustainable Sugarcane

There is substantial potential for production of bioethanol from sugarcane plantations in several countries of Africa (such as Malawi, Mozambique, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe) and many Small Island Developing States (SIDS) in the Caribbean and Indian Ocean. But the bulk of this potential has not been realized. This project will assess bioethanol potential from sugarcane in Africa and on Islands, the costs of bioethanol from sugarcane in comparison to those of petroleum-derived petrol, effective policy strategies that have been utilized to encourage ethanol production from sugarcane, and potential resulting benefits for economies and livelihoods..

SR-4 Understanding Mass Balances in Sustainable Use of Forest Wood

The carbon balances of using forest wood for energy and other purposes depend on the shares of wood used for different purposes (such as energy, pulp, and lumber), the length of time that wood remains intact, and carbon emissions displaced (from fossil fuels for energy production, concrete in buildings). This project will identify the key data requirements for understanding how sustainable a country's use of wood is, by examining the inputs and outputs of forest products in countries with large managed forest areas. It will document the shares of total forest production that are left on the ground (emitting carbon dioxide or methane) and converted to different products (such as lumber, pulp and energy wood), how long these products store carbon (such as in buildings, furniture or paper), how much carbon is displaced (such as in energy production from fossil fuels, or in construction using concrete).

SR-5 Understanding Mass Balances in Sustainable Use of Farm Residues

The carbon balances of using farm residues for energy depend on the shares which are burned, left on the ground, or collected. This project will identify the key data requirements for understanding how sustainable a country's use of agricultural residues is, by examining the use of residues in countries with large amounts of agricultural land. It will document the respective shares of food crop residues that are burned in the fields (producing carbon dioxide without useful energy), left in the fields but not incorporated in the soil (emitting carbon dioxide or methane without adding to soil nutrients or carbon), or collected (for use as animal feed or combustion to useful energy).

Technology Pathways Pillar (TP)

TP-1 Biorefineries with High Value Chemicals and Materials

The economic prospects of advanced liquid biofuels may crucially depend upon the potential for high-value co-products in biorefineries to reduce the net costs of producing them. This project will review the most promising chemical and material co-products, their current and projected market values, and their prospective market volume to evaluate their aggregate impact on net biofuel production costs. As part of the review, it will document the mix of products and costs at biorefineries planned or operating.

TP-2 Baseload Power from Biogas with Variable Wind and Solar

The most valuable use of biogas on power grids, in both energy terms and carbon terms, is to displace fossil-fueled power from coal, oil or natural gas when variable wind and solar power is not available. This project will evaluate the cost of providing baseload electricity by combining controlled use of biogas with variable wind and solar, considering both capital costs and short run marginal operating costs. It will then compare the cost with that of baseload generation from coal or natural gas, considering both market prices for these fuels and the price impact of possible market values for carbon emissions. It will also show how time-of-day tariffs are integral to promoting such biogas use for electricity generation.

TP-3 Bioenergy Costs – Energy Cane vs Sugarcane

Compared with conventional sugarcane, "energy cane" may have four times as much energy content. This project will compare the cost of advanced liquid biofuel from energy cane with that of ethanol from regular sugarcane, considering on the one hand that energy cane may yield up to four times as much energy as conventional sugarcane, but on the other hand that lignocellulosic processes may be only half as efficient as conventional processes and are so far considerably more expensive. It will also assess the potential for technology advancements to make the use of energy cane lignocellulose more competitive.

TP-4 Technical Case Studies of Advanced Liquid Biofuel Plants

IRENA's *Innovation Outlook Advanced Liquid Biofuels* has catalogued the economic potential for various processes to produce liquid biofuels from lignocellulosic feedstocks like farm and forest residues, high-yielding grasses, and short-rotation wood crops. This project will identify specific demonstration plants that exist or are being built. It will document the mass and energy balances of feedstocks going in and biofuels coming out, the feedstock costs and logistics of feedstock collection, the mix of biofuels and co-products produced and their respective market values and revenue streams, the technology innovations employed, and the reductions in capital and operating costs these innovations have made possible.

TP-5 Technical Case Studies of Bioenergy for Agroprocessing

Agroprocessing industry is a logical market for heat and power from food crop residues, since food is often processed near the farms where it is produced and the associated residues are also easy to collect. This project will identify specific agroprocessing plants that are using agricultural residues to supply all or most of their electricity and process heat in a variety of settings in Africa, Asia and Latin America. It will document what types of residues are used, what shares are used of total residues available, what sorts of combined heat and power plants are employed at what scale and with what efficiency, and how the costs compare with those of heat and power from local fossil-fueled generators or power grids.

Scaleup Tools and Strategies Pillar (ST)

ST-1 Improved Bioenergy Simulator for a Mix of Food and Fuel Crops

Agroforestry strategies are critical to expanding bioenergy production in developing countries, as they combine food crops with nitrogen-fixing wood crops that work to fertilize the soil and raise food yields, so that large amounts of wood can be produced on smallholder plots without reducing food production. IRENA has developed the Bioenergy Simulator to help smallholders choose the most productive and profitable mix of food and fuel crops for their land, but localized wood crop yield data are not available. This project will develop localized values for wood crop yields in collaboration with FAO and other partners – through direct measurement or an algorithm based on soil, water and climate data.

ST-2 Strategies to Reduce Waste and Losses in the Food Chain

FAO has noted that waste and losses in the food chain amount to a third of all food produced, and IRENA has shown how applying best practices could reduce such waste and losses by half, so that a sixth of all land currently used for food production could be freed up to grow feedstocks for bioenergy. This project will work with FAO to assess the potential reduction in losses at different stages of the food chain (production, post-harvest handling and storage, processing and packaging, distribution, and consumption) from practices like renewable refrigeration and food drying, better harvesting techniques, discounting imperfect food items to encourage their sale, modifying labels on food products so good food is not discarded, and educating consumers to match food purchases to their needs.

ST-3 REstore – Developing Wood Crops on Degraded Land

Pursuant to the Bonn Initiative and New York Declaration, countries will be making pledges to restore some 350 million hectares of degraded land which is not in productive use or is not as productive as it could be. This project will work with Bonn Initiative leaders and the UNCCD (United Nations Convention to Combat Desertification) to assess the potential for bioenergy from short rotation wood crops on the land countries restore (based on detailed assessment of which land would be used and the yields that could be achieved on that land in view of soil, water and climate conditions), and evaluate effective measures to give local stakeholders the economic incentive to actively engage in landscape restoration.

ST-4 Municipal Waste and Methane to Markets

Municipal waste represents a substantial resource which can be combusted to produce heat and power or converted to methane for electricity generation and transport fuel. It is particularly attractive in economic terms because there is value in disposing of the waste, so it can have a negative fuel cost – with a payment to the bioenergy producer for taking it. However, there remains a large unexploited potential, with large shares of municipal waste still incinerated uselessly or stored in landfills emitting methane to the atmosphere. This project will assess the gap between potential and actual use of municipal waste for bioenergy, evaluate the principle reasons for this gap, and document effective strategies which cities and biogas produces have used to bring municipal waste into productive use.

ST-5 Effective Bioenergy Promotion Policies

A variety of policies have been used to promote bioenergy in different countries. This project will document different types of policies for promoting bioenergy and compare their cost-effectiveness. Examples include targets for biofuel production or share of fuel use, support for fueling infrastructure, mandates for fuel flexibility in vehicles, funding or incentives for use of biofuels in transport modes which are poorly suited to electrification (such as aviation, marine shipping and heavy freight), and eligibility of electricity generation from biomass in tariffs, auctions or power purchase agreements.

ST-6 Bioenergy Scale-up Strategies for Russia

Russia has vast potential for production of bioenergy from boreal forests and food crop residues. IRENA will assist Russia in evaluating its bioenergy resources, cost-effective technology options for using these resources, policies and measures for scaling up bioenergy production, and social and environmental benefits of doing so policy support. Initial assessments could be at national level, follow-up assessments at provincial and local level as desired. Energy, agriculture and forestry experts from Russia would be closely engaged in the analysis, along with professional staff at IRENA.

ST-7 Bioenergy Scale-up Strategies for Southeast Asia

The countries of Southeast Asia have a substantial potential for production of bioenergy from farms and managed forests, as well as successful practices for food and energy production they can share. Working together with FAO, IRENA will help ASEAN countries evaluate their bioenergy resources, cost-effective options for using these resources, the potential for renewable energy for irrigation to boost output of food and fuel, the potential for renewable refrigeration and drying to reduce waste and losses in the food chain, and regional best practices for boosting output in the agri-food chain.