Hungary: Research, Development, Innovation

Proposed priorities for Cohesion Policy in Hungary – Research, Development, Innovation 2014 - 2020

Programme 1: Promoting sustainable use of renewable energy sources, work out innovative methods

Problem statement

Nowadays it is clear that the use of renewable energy resources is a must. Earlier investments for research and use of renewable energy sources were hampered by the low price of competing energy sources but because of the ever-increasing price of fossil fuels and climate change there is an urgent need for their substitution. So far, technologies which would enable a very rapid substitution of fossil fuels are not available. Investments are hindered by the rapid development of techniques as investors are reluctant to invest into a solution which can be out-of-date in a short period of time. A further problem is that sustainability aspects are not always integrated during Research and Development (R&D).

Aim of the programme

To speed up technical development in the field of renewable energy use

Objectives

- To work out a wide choice of techniques to find the best and most competitive solution
- To use technologies which consider environmental and sustainable aspects even in the course of their development
- To work out technologies which mitigate burdens on the environment
- To unify and develop research capacity

Eligible RTDI activities to be supported within the programme

- Applied research targeting the use of renewable energy sources which are suitable for being patented in the programmed period
- Innovative developments in connection with those which are already patented

RTDI activities have to consider the following factors

- Sustainability assessment in the course of the programme must be applied
- The development which is the result of the R&D has to minimize the amount of environmental emissions in the total life-cycle of the development. It has to increase the efficiency of the material and energy use in the total life-cycle
- The use of renewable energy sources has to be decoupled from the use of fossil fuels
- The use of renewable energy sources must not endanger the regeneration of natural resources and the life supporting functions which are connected to them (e.g.: water - water ecosystems; biomass - species, habitats.)
- The use of renewable energy sources must not be accompanied by irreversible changes to natural habitats. It must not be accompanied by land take from natural habitats. It must not entail the use of toxic and hazardous substances which are harmful for health and the environment in the total life-cycle e.g.: absorbents, heat exchangers etc.
- The use of renewable energy sources has to be reconcilable with other basic human necessities e.g.: food supply, recreation, cultural heritage has to be preserved
- The use of renewable energies must not have harmful health effects
- The result of the development is allowed to have only a low risk for the environment during the total life-cycle

- Facilities created during the development have to be adjusted to the landscape
- The use of renewable energies is not expected to entail long-distance transportation - an intention of local utilization is necessary
- Avoidance of waste production is needed, byproducts have to be recycled
- Waste production has to be minimized
- Reuse of waste and/or recycling
- Selective waste collection and utilization have to be ensured
- Negative external costs have to be minimized

Indicators for the projects within the programmes:
- Sustainability assessment for the projects - 100%
- Number of patents - 5
- Number of prototypes - 3
- Number of new products on the market - 1

Required finance
5 billion HUF - 17 million EUR

Programme 2: Developing smart grids

Problem statement:
Smart grids can be characterized as up-to-date electricity grids with bidirectional data transfer between the supplier and the consumer, and smart metering and monitoring systems. Smart grids can help to save energy and to reduce carbon dioxide emissions. In the EU their installation is still in its infancy - smart metering devices have been installed only in 10% of the households in the EU and the majority of them do not offer a full service. Consumers who have installed smart meters have managed to decrease their energy consumption by 10%, which still can be improved. The amount of CO_2 emissions can be decreased by 15%.[81] Smart grids offer better environmental performance than conventional systems if electricity generation from various sources is integrated.

Aim of the programme
To exploit further opportunities in smart grids and to make them widespread

Objectives
- To support the implementation of Directive 2006/32/EK about energy end-use efficiency and energy services
- To ensure the continuous financing of smart grid and smart metering innovations
- To promote energy saving
- To promote energy-efficiency objectives
- To decrease CO_2 emissions
- To increase energy supply security
- To make customers environmentally-conscious by measuring their energy consumption (the end user is informed about the real energy consumption and about the real consumption period)
- To provide precise information about grid losses, and to minimize them
- To promote the integration of small energy plants
- To increase the security of grid operation and make it more economical

Eligible RTDI activities to be supported within the programme
- Improving smart grids and smart metering models and carrying out comparative analysis among different models
- Monitoring and implementing small-scale pilot programmes
- (Successful integration of small energy facilities by smart grid and smart metering)

Sustainability criteria for taking part in the programme
- Environmental effects of the planned model have to be assessed during the research
- Preliminary environmental assessment is needed during the demonstrative projects and the development of the prototypes
- The different grid models have to be collectively compared and analyzed by all participants in the R&D.

81 http://www. itsyoursmartgrid.com/solution/consumer_management.html

RTDI activities have to consider the following:
- The development which is the result of the R&D has to minimize the amount of the emissions in its total life-cycle
- It has to increase the efficiency of material and energy use
- The result of the development may entail only low risks in the total life-cycle
- Human health must not be endangered
- Developments are not allowed to shift environmental burdens, e.g.: development should not decrease the amount of waste at the price of increasing the hazardousness of waste
- During the development of smart metering equipment waste generation has to be minimized and the materials used have to be recycled
- Negative externalities have to be minimized
- Developments have to minimize energy loss from the grid
- Developments should avoid extra cost for consumers
- Developments have to increase transparency in energy services and consumption
- Developments have to accurately indicate the careful and wasteful behaviour of consumers

Indicators for the projects within the programme:
- Smart grid models – minimum three models
- Reconciled grid models – minimum one recommended model
- Smart grid prototypes pilot project – equivalent of the number of the accepted models, minimum one
- Smart metering prototypes pilot project – minimum three different types

Required finance
13 billion HUF - 45 million EUR

Programme 3: Decreasing energy consumption by end users by raising the efficiency of energy-utilizing equipment

Problem statement
The 2020 objective of the EU, according to which energy efficiency has to be increased by 20%, is well-known. However this target is facing problems in implementation as in various places some steps have been taken to increase energy efficiency e.g.: the use of energy-saving light bulbs, but in many cases the increase in energy efficiency has come to a standstill. However, energy efficiency can be increased if we develop new working principles.

Aim of the programme
Innovation of new items of end user equipment based on new working principles (household appliances, heating and cooling systems, etc.)

Objectives
- To invent new and energy efficient working principles
- To contribute to reaching 20% improvement in efficiency by 2020
- To contribute to decreasing CO_2 emissions
- To promote to improve energy-consuming devices

Eligible RTDI activities to be supported within the programme
- Research of new working principles
- Improvements of end use equipment based on new working principles and manufacture of their prototypes

Sustainability criteria for taking part in the programme
- RTDI programmes which can reach 20% improvement in efficiency, compared to existing techniques
- Environmental performance assessment

RTDI activities have to consider the following:
- The development which is the result of the R&D has to minimize the amount of environmental emissions in its total life-cycle. It has to increase the efficiency of material and energy use in its total life-cycle. It must have only a low risk for the environment during its total life-cycle. It must not endanger human health. It must not endanger natural ecosystems
- End use items of equipment are needed which are made of recyclable materials and some components can be reused
- Negative externalities must be minimized

Indicators for the projects within the programme

- Invention of new working principles – minimum two new principles
- Innovative end user items of equipment – minimum two new items
- Development has to concern households – in minimum one case
- Savings by the end user have to reach minimum 20% compared to the previous equipment
- The energy saving potential of the development has to reach in the concerned consumer group a 5% decrease in total energy consumption

Required finance

2 billion HUF - 7 million EUR

Programme 4: Promoting sustainable architecture

Problem statement

Increasing energy prices are pushing users to save energy, and subsequently designers to design energy-saving houses. As a result, passive houses are appearing. Another issue is independence from the large energy supplying systems, which is reflected in the building of autonomous houses. The problem is that these trends are not associated with an architecture that is striving to be environmentally-conscious and sustainable in all aspects. Saving energy, increasing energy efficiency and being autonomous often entail burdens on the environment in the form of high energy demand at construction and high use of plastics. Another problem is that in buildings that serve different functions different techniques have to be used so the same environmentally-friendly techniques cannot operate in all of the cases. The fact that all houses have to be adjusted to their environment, and have to be designed and implemented as an integral part of it, makes the matter even more complicated.

Aim of the programme

To promote sustainable architecture through RTDI

Objectives

- To promote environmentally-conscious architecture, material and energy efficiency and savings
- Sustainable architecture to meet with needs instead of wishes
- To promote solutions which entail the use of local construction materials
- To promote the life-cycle view in architecture
- Architecture supports a sustainable life style
- Buildings are environmentally sound

Eligible RTDI activities to be supported within the programme

- Working out criteria for sustainability
- Working out innovative technological solutions
- Developing innovative construction materials
- Developing innovative building engineering
- Patenting innovative solutions
- Introducing prototypes

RTDI activities have to consider the following:

- Preliminary sustainability impact assessment to assess the consequences of innovative solutions
- The minimization of energy and material use in the whole life-cycle (building material, construction, operation, deconstruction)
- Giving priority to renewable resources
- Minimizing the space that is irreversibly used by the construction
- Enhancing the efficiency of energy and material use
- Minimizing negative external costs
- Innovation has to achieve better environmental performance than the existing BAT
- Avoiding risks and considering the precautionary principle
- Considering the long term environmental effects on human health
- Considering local traditions which have proved to be environmentally sound
- Promoting the sustainable use of local materials
- Using the surrounding ecological conditions, instead of changing them
- Minimizing the waste stream in the whole life-cycle
- Avoiding materials which might have toxic impacts

Indicators for the projects within the programme
- The number of patents of innovative construction materials – 5
- The number of prototypes of innovative construction materials – 3
- The number of patents of innovative construction technologies – 3
- The number of patents of innovative building engineering technologies – 3
- The innovation's energy saving potential has to be at least 20% compared to the BAT
- 5% of new buildings apply at least half of the programme's innovative technologies

Required finance
2 billion HUF - 7 million EUR

Programme 5: Innovative practices of sustainable land use

Problem statement
Soil degradation – loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants or excessive flooding – is a serious global environmental problem and may be exacerbated by climate change. Soils host the majority of the world's biodiversity and healthy soils are essential to securing food and fibre production and providing an adequate water supply over the long term. Ecosystem services provided by soils are integral to the carbon and water cycles and include cultural functions.

Soil is lost much faster than it is created through normal geological processes. It takes 200 to 1,000 years to form 2.5 cm of rich topsoil. But on average, farmland in Europe is losing 2.5 cm of topsoil every 16 years, or 17 times faster than it can be replaced.

The loss of topsoil affects man's ability to grow food in two ways. First, it reduces the inherent productivity of land, both through nutrient loss and degradation of the soil's physical structure. Second, it increases the cost of food production. When farmers lose topsoil, they can only increase land productivity by substituting energy in the form of fertilizer, and this increases the costs (inputs). But if productivity drops too low or costs rise too high, they will be forced to abandon their land.

Studies have shown that as much as 20 percent of eroded materials end up in rivers, reservoirs, and irrigation canals.

Aim of the programme
Speed up innovation of sustainable land use practices to prevent soil degradation

Objectives
- To prevent further degradation of top soil by climate change
- To maintain soil ecosystem services
- To rehabilitate and enhance soil biodiversity
- To protect and enhance the nutrient cycle and to enhance soil fertility
- To find innovative tools and techniques to conserve and build soil
- To minimize synthetic fertilizer use
- To find ways to eliminate energy wasting practices
- To find practices to increase water infiltration and prevent rapid surface run-off.
- To find ways for the multifunctional use of ecosystems
- To develop holistic management

Eligible RTDI activities to be supported within the programme:
- Research aimed at innovative sustainable land use practices to prevent soil degradation
- Small scale testing of existing (but not applied in Hungary yet) and innovative sustainable land use practices, such as contouring; cover cropping; crop rotation; contour strip cropping; contour buffer planting; terracing, grassed waterways; farm ponds and checks dams; Sloping Agricultural Land Technology (SALT); alley farming and agroforestry; no tilling, etc.
- Monitoring changes in soil properties due to innovative land use practices

Sustainability criteria for taking part in the programme
Monitoring and measuring activities have to be completed in order to obtain a clear indication of results

RTDI activities have to consider the following:
- Reducing total – direct and indirect – fossil energy input into land use
- Supporting the recovery and maintenance of ecosystems services
- Minimizing artificial chemical input
- Preservation of top soil - top soil loss cannot be faster than regeneration
- The soil's biogeochemistry has to be maintained
- The soil's biodiversity has to be enhanced
- The soil water regime has to be maintained

Indicators for the projects within the programme:
- Change of EROEI (Energy returned on energy invested) due to the innovative techniques compared with the traditional ones – 20% improvement of energy efficiency
- Soil degradation data set – less than 2.5 tonnes of soil loss per ha
- Total biomass in soil – 100% increase compared to the previous practice within the last 5 years

Required finance
3 billion HUF - 10.5 million EUR

Programme 6: Sustainable forest management RTDI

Problem statement
Forests are essential to economic development and the maintenance of all forms of life. Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations. Sustainable management means "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems".

Climate change may endanger natural forest habitats if changes exceed the resilience of forest ecosystems. As most forest structures have been changed in the past, and almost half of the stands consist of non-indigenous species the stress tolerance of forests is a question in general.

Forests differ in the regeneration requirements of their most valuable species and in their sensitivities to different silvicultural treatments. Even good management practices may result in unforeseen losses in non-targeted species, soil, water balance, etc.
RTDI activities are badly needed to find and test sustainable forest management methods.

Another problem is the growing demand for forest products, which extracts a part of the biomass from the forest. There is no known exact method to identify the extent to which biomass can be extracted without compromising the forests' ecosystem services and biodiversity.

The forest industry in most cases manages forests as if they were plantations and not an ecosystem. The resilience of an ecosystem depends on all elements of the system, and not just on the trees. RTDI activities have to consider forest as an ecosystem.

Aim of the programme
To enhance stress-tolerance to climate change and improve biodiversity of forest ecosystems by RTDI activities

Objectives
To understand the relation between forest management methods and resilience of forest ecosystems
- To develop adequate forest management for adaptation to climate change
- To enhance the resilience of forest ecosystems
- To develop adequate forest management to preserve the multiple and complementary functions and uses of forest ecosystems.
- To reduce risks linked to abandonment, desertification and forest fires
- To protect the soil's carbon supply and fixing cycles to increase the forest carbon stock
- To promote sustainable forest management practices, afforestation and reforestation
- To prevent soil degradation, greenhouse gas emissions

- To identify the raw material of different forest habitats that can reproduce itself naturally and maintain biodiversity in a changing climate

Eligible RTDI activities to be supported within the programme:
- Research on stress tolerance of different forest habitats concerning climate change
- Innovation of new management practices
- Testing new management practices
- Testing existing and applied sustainable management practices
- Research on forest rehabilitation
- Innovation of new rehabilitation methods including reforestation
- Innovation of new methods of afforestation

Sustainability criteria for taking part in the programme
- The RTDI team has to apply an ecosystem approach
- The RTDI team has to represent various fields of expertise
- Monitoring and measuring activities have to be completed

RTDI activities have to consider the following:
- Health and vitality of forest ecosystems
- Soil and water protection of forest ecosystems
- The conservation and enhancement of biodiversity of the whole forest ecosystem, including the genetic diversity of the trees

Indicators for the projects within the programme:
- Innovation of new management practices – 2 practices
- Trial and testing of new management practices – 2
- Testing of existing and applied sustainable management practices – 2
- Research on forest rehabilitation – 1
- Innovative rehabilitation methods including reforestation – 1
- Innovative method of afforestation – 1

Required finance
2 billion HUF - 7 million EUR

Programme 7: RTDI projects on wise resource use for waste prevention through the integration of production and consumption

Problem statement
Production is consumption of resources and creation of waste, while consumption is production of waste. This simple fact provides an opportunity to combine production and consumption into one cycle. The problem is that there is no intentional planning of such cycles - the work is done by the market. The market sometimes fails to manage waste problems, as it does not reflect on the negative external costs, potential partners are frequently not matched, and the management of small amounts of waste is not cost efficient. Information on what to do with the waste, where to take or dispose of it, and who can manage it is poor. Though most waste is a resource, which can bring benefit for the owner, in most cases this asset is lost, and turns into a cost.

Another problem is that the different actors belong to different sectors and cross sectoral cooperation is rare. Some cycles exist in cases where partners have been matched, but there is no overall map to provide information on the opportunities.

Aim of the programme
To promote the planning of an integrated production and consumption cycle in Hungary to minimise waste.

Objectives
- To promote matching of potential partners
- To help cross sectoral cooperation
- To provide knowledge and information for the creation of cycles
- To find solutions for existing waste problems

Eligible activities
- Surveying the production and consumption system
- Mapping recent cooperation among consumers and producers
- Mapping existing cycles
- Developing a data bank for matching partners
- Coming up with concrete proposals for matching

Sustainability criteria to take part in the programme
- The RTDI team has to represent various field of expertise
- The results of the RTDI activities have to be publicly accessible and free of charge

RTDI activities have to consider the following:
- Waste minimisation
- The proposed cycling has to avoid negative environmental side effects, such as long distance transport, or shifting environmental burdens to other sectors or other sites.
- Proposals have to minimise hazards (i.e. hazards potentially caused by waste, e.g. soil and air pollution and the consequences thereof, incl. threat to the health of living organisms; as well as hazards posed by the use of raw materials for unsuited purposes, e.g. plastics containing heavy metals used for toys; hazards implied in the extraction of excessive vegetal waste from the cycle of organic matter as a consequence of biomass-based energy production)[82]

Indicators for the projects within the programme:
- A study on the Hungarian production and consumption system is completed
- A plan suggesting how to combine production and consumption into a cycle is completed
- A data bank on existing cycles and partners is developed
- A data bank for users to promote new cooperation is developed

Required finance
1 billion HUF - 3.5 million EUR

Programme 8: New, bio-based biodegradable materials RTDI

Problem statement
The availability of cheap oil is predicted to become more and more limited in the near future, and the negative environmental impacts during its whole life cycle are well known. We need materials to replace fossil oil and its products, and to avoid environmental harm.

Sustainability, industrial ecology, eco-efficiency, and green chemistry are guiding the development of the next generation of materials, products, and processes. Biodegradable plastics and bio-based polymer products based on annually renewable agricultural and biomass feedstock can form the basis for a portfolio of sustainable, eco-efficient products that can compete and capture markets currently dominated by products based exclusively on petroleum feedstock. Natural/Biofiber composites (Bio-Composites) are emerging as a viable alternative to glass fibre reinforced composites especially in automotive and building product applications. The combination of biofibres such as kenaf, hemp, flax, jute, henequen, pineapple leaf fibre, and sisal with polymer matrices from both nonrenewable and renewable resources to produce composite materials that are competitive with synthetic composites requires special attention, i.e., biofibre–matrix interface and novel processing. Natural fibre–reinforced polypropylene composites have attained commercial attraction in the automotive industries.

In recent years there has been a marked increase in interest in biodegradable materials for use in packaging, agriculture, medicine, and other areas. In particular, biodegradable polymer materials are of interest. Several new plastics have been launched that are biodegradable.

Using natural fibres with polymers based on renewable resources will allow many environmental issues to be solved. By embedding biofibres with renewable resource–based biopolymers such as cellulosic plastics; polylactides; starch plastics;

82 The proposed programme aims to reduce waste production through the integration of production and consumption processes. I.e. all the outputs (incl. by-products, waste) of a process should be absorbed by other productive processes along a consciously planned cycle. This way, hazards could be eliminated / minimized.

polyhydroxyalkanoates (bacterial polyesters); and soy-based plastics, so-called green bio-composites are continuously being developed.

Bio-based and biodegradable are likely to be fashionable, but these labels do not automatically mean that they are environmentally friendly. Typical problems are as follows:

- When biodegradable refuse ends up in landfills, it breaks down more quickly than ordinary waste does. The result is a more rapid release of methane, a greenhouse gas with a high global warming potential.
- Natural fibre—polypropylene or natural fibre—polyester composites are not sufficiently eco-friendly because of the petroleum-based source and the non-biodegradable nature of the polymer matrix.
- Some bio-based material biodegrades rapidly, and its short life causes frequent use of raw materials. e.g. PLA (Polylactic acid).

The biggest problem is the quantity of bio-based biodegradable materials used by humans. Bio-based materials are always part of the food chain or can be foodstock for humans. The best example is agrofuels, which require huge areas for production and has resulted in fuel competing with food.

Research is urgently needed to combine the idea of bio-based and biodegradable materials and avoid the environmental problems associated with most of the new materials developed so far.

Aim of the programme

To find bio-based and biodegradable new materials to minimise environmental burdens.

Objectives

- To avoid the most common environmental problems associated with bio-based and biodegradable materials
- To find new materials which are both bio-based and biodegradable

Eligible activities

- To assess the environmental performance of existing bio-based and biodegradable materials
- To improve the environmental performance of existing bio-based and biodegradable materials
- To find new bio-based and biodegradable materials, which meet both criteria.

Sustainability criteria for taking part in the programme

- The RTDI team has to represent various fields of expertise
- An overall LCA has to be carried out concerning the new materials
- Results of the environmental assessment have to be publicly accessible in the case of existing materials.

RTDI activities have to consider the following:

- Biodegradable and bio-based criteria have to be applied in parallel
- New materials have to have a better environmental performance during their life cycle than existing ones.
- Shifting environmental burdens has to be avoided during the whole life cycle
- Social aspects, such as the nourishing the human population and job opportunities have to be taken seriously into account.
- Biodiversity and the food chain have to be considered carefully.
- New materials have to be aimed at waste prevention
- The durability of the materials has to be considered properly

Indicators for the projects within the programme

- Environmental impact assessment of existing bio-based and biodegradable materials – 3 cases
- Improved environmental performance of existing bio-based and biodegradable materials – 2 cases
- Patents on new bio-based and biodegradable materials – 2 cases

Required finance

3 billion HUF - 10.5 million EUR

Summary of the programmes and indicators

Priority Strengthening research, technological development and innovation	Type of indicator	Indicator	Milestone for 2016	Milestone for 2018 (cumulative)	Milestone for 2022 (cumulative)
Sustainable use of renewable energy sources – innovative technol	Output indicators	To carry out sustainability assessment for the projects			100%
		Number of patents		1	5
		Number of accomplished prototypes		1	3
		Number of new products on the market		-	1
	Result indicator	Fossil fuel replacement decreasing energy dependency			
Smart Grid RTDI	Output indicators	Smart grid models – minimum three models		1	3
		Reconciled grid models – minimum one recommended model			1
		Smart grid prototypes pilot project – equivalent of the number of the accepted models, minimum one			1
		Smart metering prototypes pilot project – minimum three different types	1	2	3
	Result indicator	Local production of electricity is feasible from renewables, and integrated into the system, efficient power delivery			
Energy efficient appliances RTDI	Output indicators	To invent new working principles – minimum two new principles	-	1	2
		Innovative end user items of equipment – minimum two new items		1	2
		Development has to concern households – in minimum one case			1
		Savings of the end user have to reach minimum 20% compared to the previous equipment			20%
	Result indicator	Energy saving potential of the development has to reach in the concerned consumer group 5% decrease in the total energy consumption			5%
		Decreasing electricity consumption in households			
Sustainable architecture RTDI	Output indicators	Innovative building materials and technologies			
		The number of patents of innovative construction materials	1	3	5
		The number of prototypes of innovative construction materials	1	2	3
		The number of patents of innovative construction technologies	1	2	3
		The number of patents of innovative building engineering technologies	1	2	3
		Innovation energy saving potential has to achieve 20% compared to the BAT			20%
		5% of new buildings apply at least half of the programme's innovative technologies			5%
	Result indicator	Decreasing energy consumption of buildings			

Priority Strengthening research, technological development and innovation	Type of indicator	Indicator	Milestone for 2016	Milestone for 2018 (cumulative)	Milestone for 2022 (cumulative)
RTDI projects on wise resource use for waste prevention by the integration of production and consumption cycle	Output indicators	A study on the Hungarian production and consumption system	1	1	1
		A plan suggesting how to combine production and consumption into cycle		1	1
		A data bank on existing cycles and partners		1	1
		A data bank for users to promote new cooperation			1
	Result indicator	Minimisation of resource extraction and prevention waste			
Sustainable land use – agricultural practices which prevent soil degradation RTDI	Output indicators	Innovative sustainable land use practice – 3 patents	1	2	3
		Test of innovative land-use practice – 1 case		1	1
		Small scale field test of existing practices – 5 cases		5	5
	Result indicator	Prevention of soil degradation and biodiversity loss decreasing GHG from soil cultivation			
Sustainable forest management RTDI	Output indicators	Innovation of new management practices – 2 practices		2	2
		Trial and testing new management practices			2
		Testing existing and applied sustainable management practices	2	2	2
		Research on forest rehabilitation		1	1
		Innovating rehabilitation methods including reforestation			1
		Innovating methods of afforestation			1
	Result indicator	Adaptation to climate change, measured by existing indicators, along with the monitoring of the change of climatic features[83]			
New, bio-based biodegradable materials RTDI	Output indicators	Environmental assessment of existing bio-based and biodegradable materials – 3 cases	3	3	3
		Improved environmental performance of existing bio-based and biodegradable materials – 2 cases		1	2
		Patenting of new bio-based and biodegradable materials – 2 cases			2
	Result indicator	Decreasing environmental pressure			

Prepared by: Dr. Iván Gyulai

83 Existing indicators to measure the fitnes (adaptability) of forest ecosystems to climate change include: the loss of leaves, shrivelling/desiccation of the tree-top or the whole tree, change in the number/population of the tree's pests, invasion and spreading of invasive species in the forest, change in the diversity of the forest, change in the production of organic matter etc. All these indicators have to be interpreted together with the change of climatic