A4L_ACTIONS

Alliance for Life Sciences: From Strategies to Actions in Central and Eastern Europe

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D1.8 REPORT ON GREEN LABS PILOTING

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INTRODUCTION

There is a growing understanding that scientific research is highly energy-intensive and generates a huge amount of single-use plastic lab waste, thereby having strong negative impact on the local and global environment. To reduce this negative impact while preserving proper conditions for investigations in biomedical area (sterility, GMO safety, etc.), we aimed to introduce, pilot and/or upgrade a Green Lab concept in the research practices of the A4L_ACTIONS partner institutions. For that purpose, we first performed an initial survey and collected brief reports on the status of environmental laboratory policies and procedures in A4L partner institutions at the beginning of the WP1 implementation, in 2021. Results were analysed and described in the Deliverable D1.7, see https://alliance4life.ceitec.cz/green-labs-best-practice/.

The initial survey demonstrated that most of the A4L_ACTIONS partners were basically aware of the environmental policy value and were already in the process of its partial implementation. Furthermore, the survey identified aspects of the green lab concept that were insufficiently addressed and indicated that there was a space for improvements.

SUMMARY OF THE 2nd SURVEY RESULTS ON GREEN LABS PILOTING

The 2nd survey performed in 2024 repeated the structure of the 1st one in order to map advances in piloting the Green Lab concept. As previously, it consisted of six sections addressing basic topics of environmental policy and/or practice and one free text option:

1. General aspects of environmental policy
2. Purchase and sharing equipment and consumables
3. Recycling
4. Energy and water
5. Chemical management
6. Laboratory waste

Each section contained 6-14 questions related to the respective topic (see the template in the Attachment to D1.7 and Annex 1 to this D1.8). Responses to particular questions were provided in binary form (response yes = 1, response no = 0) in order to allow for calculation of % positive (and partially positive) responses for each category of questions and for rating of overall status of this topic. All A4L_ACTIONS partners participated in the survey and the results were anonymised.

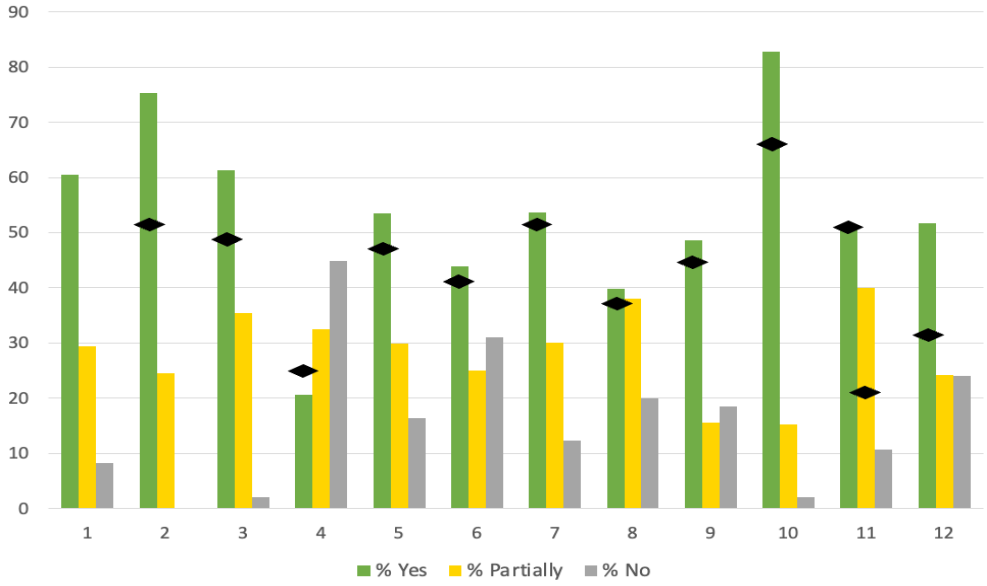

Figure 1. *Overall percentage of responses (Yes, Partially, No) to all questions in the survey, provided by each A4L_ACTIONS partner. Full black diamonds indicate % of Yes responses in the 2021 survey.*

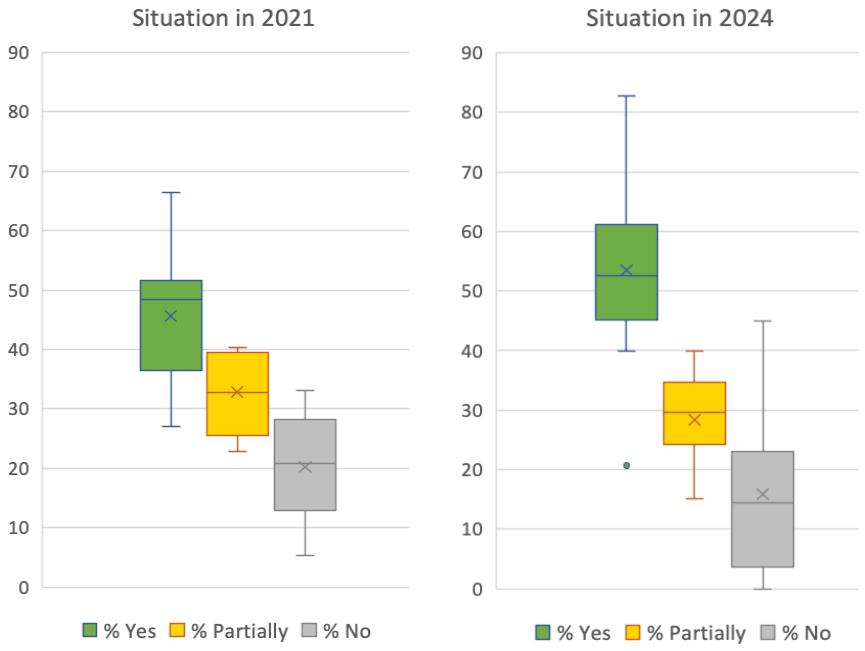

Figure 2.
Overall percentage of responses (Yes, Partially, No) to all questions in the survey, given together by all partners in 2021 and 2024. Box plot with indicated interquartile range and median (—) and average (x).

The graphs on Figure 1 show that the partners implemented rules and practices of environmental policies to a variable degree. Median value of "Yes" responses corresponds to 52,6 % (compared to 48,4 % in 2021) and average to 53,5 % (vs to 45,7 % in 2021), median of "Partially" is 29,7 % (vs 32,8 % in 2021) and average is 28,3 % (vs 32,8 % in 2021), median of "No" is 14,4 % (vs 20,9 % in 2021) and average is 15,9 % (vs 20,21 % in 2021). These numbers indicate overall improvement, which is most prominent in case of the partners 2, 3, 5, 10 and 12.

However, the progress in better visible when looking at the overall responses assembled according to the survey topics as illustrated on Figures 3 (column graph) and 4 (radar graph). As before, the implementation is most advanced in the management of laboratory waste, which is the topic that is covered by national legal regulations and accomplished in practice in all A4L_ACTIONS partners' institutions. Additional topics that remain relatively well addressed include energy and water, recycling and chemical management at least partially because their management is subject to strict regulatory rules.

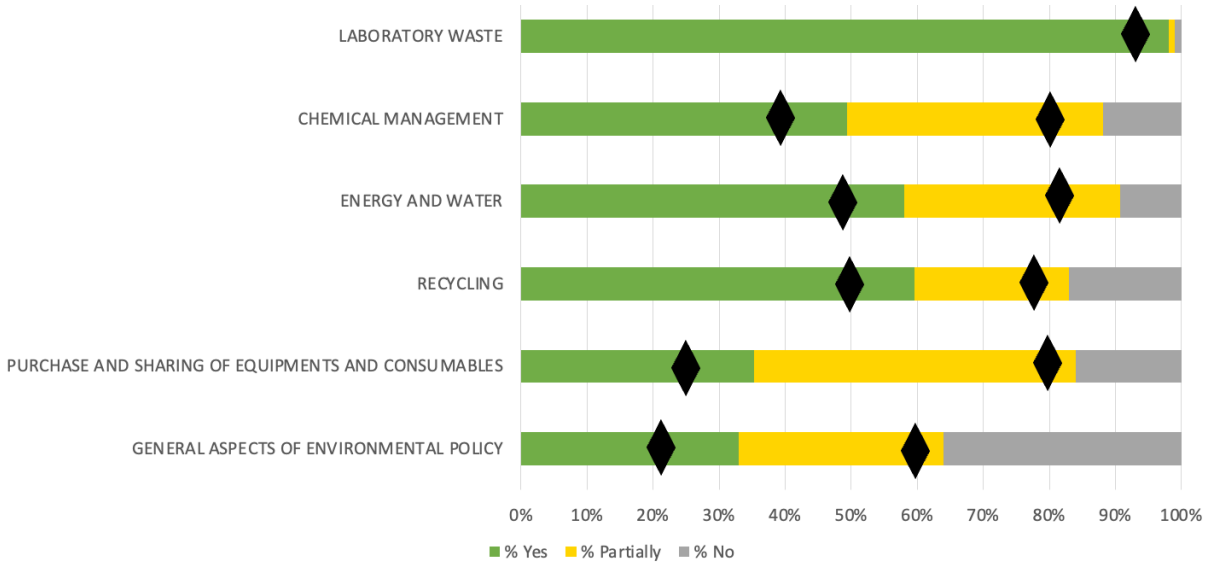

Figure 3.
Average percentage of responses (Yes, Partially, No) to questions included in the survey topics by all partners.

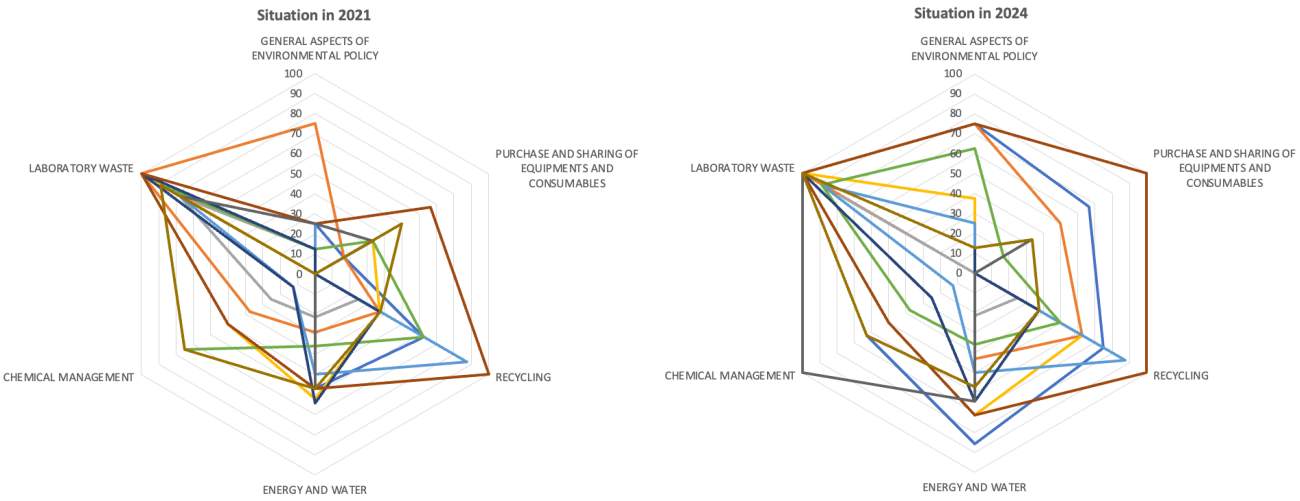

Figure 4.
Radar graph illustrating average percentage of "Yes" responses by each A4L_ACTIONS partner participating in the survey 2021 (left) and 2024 (right), to the topics of environmental policy. Individual partners are discriminated by colors.

The topics that would still require attention include purchase and sharing of equipment and consumables and general aspects of environmental policy, which cover awareness, guidelines, training etc. These latter topics represent potential areas of future activities. Nevertheless, overall improvements are clearly evident.

Individual responses of the partners to all questions of the survey topics are exhibited together in the Annex 1 to this document. Background information explaining the survey topics is the same as described in the Deliverable D1.7 and thus is not repeated here.

A4L_ACTIONS ACTIVITIES TO IMPROVE AWARENESS OF ENVIRONMETAL FOOTPRINTS OF RESEARCH

During the A4L_ACTIONS project performance period, the awareness of environmental impact of the biomedical research was supported by two events.

1. On November 15, 2023 **the conference on sustainable science titled "Sustainable Science – What is the Environmental Footprint of Scientific Knowledge Creation?"** was organised by the Institute of Molecular and Cell Biology and the Centre for Sustainable Development, **University of Tartu.**

   It was the first conference focused on the environmental burden of creating scientific research itself among Estonian universities, which brought together experts from all local major universities and research funders. The whole-day event focused on the **footprint of creating scientific knowledge,** which has not been discussed in Estonia among scientific organizations in public before. Scientists are expected to solve complex problems of climate change, but there is less talk about the environmental impact of scientific work itself, which also requires attention and consideration as **science is extremely resource intensive**.

   The moderators of the event were **Margit Keller** (Associate Professor in Social Communication, Head of the Centre for Sustainable Development, UT) and **Toivo Maimets** (Professor of Cell Biology, UT, Head of the Scientific Council of the Government of Estonia, Deputy-Chair of the Alliance4Life). The conference hosted several experts who tackled important aspects of the environmental

footprints of biomedical research, such as energy consumption, carbon emissions, plastic waste, data collection, preservation and waste, electronic waste. Several talks were dedicated to importance of circular economy and measurements of carbon footprint as an indicator of science sustainability and environment-friendly behaviour of the researchers and research institutes. The conference provided very interesting insights into the topic and promoted thoughts about sustainable behaviour at both individual and institutional level.

Mari-Liis Štrik-Ott, Environmental Sustainability Adviser, University of Tartu, introduced the **Environmental Overview of the University of Tartu.** The presentation included the results of the first environmental overview of the university (2019-2022), the overview of the carbon footprint of the university (2019-2022) and the introduction to the environmental management system, which the university wants to establish.

For more details on the conference talks, see https://alliance4life.ceitec.cz/news/alliance4life-hosted-the-first-conference-on-sustainable-science-in-estonia/. **The ideas presented by the conference speakers can be very inspiring for the entire A4L consortium as well as for any other entities.**

2. In the period 20-22.04.2023, the Alliance4Life Green Second Trigger Event Sofia was held at the Medical University – Sofia.

   During two consecutive days, in two thematic Workshops, the participants had the opportunity to present their green visions for the transformation of higher education, in the context of the started process of digital transition of their education systems. The coordinator of the local Alliance4Life team, **Prof. Tsvetalina Tankova**, Vice-rector for International Integration and Project Financing, presented the achievements of the members of Alliance4Life. The workshop included talks on green policies and solutions for city of Sofia, health challenges of global climate change, in silico approaches for green science and innovation, and the relevance of regional divides for the green transition and challenges to universities futures.

   For more details on the conference talks, see https://alliance4life.ceitec.cz/news/alliance4life-green-second-trigger-event-was-held-at-mu-sofia/

GREEN LAB CONCEPT PILOTING IN THE A4L_ACTION PARTNERS' INSTITUTIONS DURING 2021-2024

Piloting of the Green Lab concept has been influenced by the global as well as context-specific circumstances of the partner institutions. The COVID-19 pandemics strongly affected particularly those A4L_ACTIONS partner institutions that actively participated in the SARS-Cov-2 virus surveillance / infection monitoring by molecular and serological testing, and in the provision of medical care for COVID-19 patients. Those institutions had to continue in energy-, plasticware- and reagent-intensive operations that were inevitable for the effective mitigation of the pandemic threats. On the other hand, researchers of institutions that did not actively participate in the mitigation of pandemics were limited in their research and practical accomplishments of their project activities. Both situations diverted the attention of researchers from the environment protection to other, more urgent issues. Moreover, the time period for the recovery since the resolution of the pandemics has been relatively short for the achievement of more dramatic changes in the Green Labs piloting, so the process is still ongoing.

Additional specific circumstances that negatively affected GL piloting was the earthquake, which destroyed the Universizy of Zagreb Schoold of Medicine facilities that are still in the process of

reconstruction. Laboratories had to be transferred to other available spaces, mostly inadequate for the laboratory work and therefore since that moment it has been difficult to implement any Green Lab concept.

The implementation of the GL strategy is also complicated at the University of Ljubljana Faculty of Medicine due to the fact that its infrastructure is dispersed (due to historical development of the faculty). It means that some departments, which have been built more recently, have more advanced level of environment protection, such as better energy efficiency, etc. than others, which are still situated in older buildings. Nevertheless, strict standards are imposed for work with GMOs, animals, radioactivity etc. regardless of the age of the building. If these standards are not met, the work cannot be performed. Open issues and limitations in GL strategy imlementation will be actively addressed when the new campus on Vrazov trg opens (in 2026). The plan for the new state-of-the-art facilities has been approved and the construction has started. The new building will contain technical and other solutions which have not been possible with departments scattered across several buildings. The new campus will include medical research centre that will house common equipment which will be shared among research groups. In the new building, environmental, technical, and organizational solutions will be streamlined. The new campus will also have new advanced and markedly expanded animal facility. This will create conditions for environmentally-friendly operations.

On the other hand, University of Tartu (UT) has made several important steps towards GL concept implementation, such as:

1. accomplishing 2024-2025 public procurement: 100% electricity bought by UT is produced from renewable energy sources. This was done to reduce the GHG footprint. Electricity use accounts for a significant portion (44%) of the university's GHG footprint,
2. reducing energy consumption and increasing energy efficiency of buildings by construction of larger and smaller solar parks, acquired batteries for storing solar energy, updated and automated heating, cooling and ventilation systems, replacemenet of energy-stealing lights with LED lamps in both indoor and outdoor spaces, and adopting the Emajõe district cooling system in some buildings (Emajõgi - river in Tartu),
3. taking into account environmental conditions when preparing the technical specifications of public procurement objects,
4. in 2022, opening the Center for Sustainable Development at UT; in Nov 2023 organizing a conference on creating scientific knowledge and its sustainability (mentioned above),
5. in 2023, creating the position of Environmental Sustainability Adviser,
6. in autumn 2023, launching a movement study of UTARTU students and employees that was finalized in report in March 2024 showing the impact to sustainable movement patterns and solutions in many cities in Estonia (Tartu, Tallinn, Narva, Viljandi, Pärnu - all connected with the University of Tartu); the movement patterns of all students and employees mapped and shortcomings patterned (parking data, secondment data, movement of studens across the city according to lesson plans - a good way to find solutions together with local municipalities and state),
7. Organising web seminars on several topics by Mobility Lab of UTARTU is (e.g. how climate policy will affect movement in towns, pedestrians and their movement corridors in towns,
8. developing UT Environmental Review for 2019-2022.

Biomedical Research Center SAS (BMC SAS) has recently accomplished an internal program on the development of the Green Lab strategy tailored to the specific needs of the biomedical research institution working with toxic, carcinogenic, infectious, and GMO biologicals, disposable plastics and other research materials requiring special treatment. The guidance throughout the process of the elaboration and implementation of the GL rules was provided by the INCIEN (Institute of Circular Economics), a civic non-profit association, which is the leader in this topic in Slovakia. The INCIEN experts provided series of educative lectures on principles and challenges of waste management. In collaboration with the BMC SAS GL ambassadors, they also performed an audit of waste volume and

composition in the BMC SAS laboratories as well as an audit of energy consumption before, during and after the COVID-19 pandemics. Based on collected data, they elaborated a detailed report called "The road to carbon neutrality" including quantitative evaluation of BMC SAS emissions, calculation of carbon footprint and identification of its major sources as well as proposal of potential opportunities for future improvements and savings.

In 2023, Medical University of Łodz (MUL) signed a Green Plan (GP), which is a MUL sustainable development program for 2022-2025. GP pertains to the aspects of sustainable development and is related to 17 Sustainable Development Goals in the 2023 Agenda, adopted by the UN General Assembly on 25 September 2015. The goals are related to activities within 5 areas, as the originally defined Three P's: PEOPLE, PLANET and PROSPERITY where further supplemented with Two P's: PEACE and PARTNERSHIP.
GP involves:

1. EcoUMED: coordination program for sustainable development created by the Medical University of Lodz in 2018 in order to establish a model → Green Campus, to support holistic concept of the culture of health and pro-ecology behaviours. The program has its own organisational unit which corresponds to Green Office, which is typically in charge of the development of → Green Campus.
2. ECO-PHILOSOPHY – a philosophical current of ecological harmony and equilibrium which combines environmental ethics and humanity values. It was created by Henryk Skolimowski (1930-2018), the founder of the Department of Ecophilosophy at the Technical University of Lodz, which he headed in the period of 1992-1996.
3. HOLISTIC-FUNCIONAL CONCEPT OF HEALTH – often described in opposition to classic/ biomedical model focused on curing illnesses i.e. to combat the symptoms of health disturbances. The holistic model, in turn, emphasises the prevention in the broad sense which ought to include 5 groups of health predispositions:▪physical: genetic burden, biological functioning, ▪mental: cognitive and emotional processes; ▪spiritual: the need to live in accordance with one's own ethical convictions; ▪social and cultural: interpersonal relations and generally approved patterns of behaviour; ▪environmental: living conditions in terms of household, workplace and external environment.
4. STARS − an acronym for The Sustainability Tracking, Assessment & Rating System, which is a multi-criteria system to measure sustainability performance applied mainly in USA and Canada. The system is to monitor the implementation progress of → Green / Sustainable Strategies in academic campuses. It has been developed since 2006 within the structure of AASHE (the Association for the Advancement of Sustainability in Higher Education) system and is constantly being upgraded in response to current environmental challenges.
5. HEALTHY PLACE 'a place in which people can grow up, live, work, play, study, pray, and age in ways that allow them to be safe and healthy, to thrive, and to reach their full potential' (Dannenberg, Frumkin & Jackson (editors), 2011, p.5). If we elaborate on the definition, we may conclude that it is about the interiors of the buildings intended for residence (dwelling houses, schools, workplaces etc.) as well as communal areas in 'constructed' environment which are mindfully planned, equipped and attended to with health needs in mind. In terms of this Strategy, the concept of a healthy place (so called climatopes) includes small parts of open or semi-open areas within the Clinical and Didactic Centre campus, designed to prevent/ mitigate adverse effects of civilization diseases. As components of the University → Living Lab, climatopes combine social utility and various aspects of adaptation to climate change.
6. HEALTHIER HOSPITAL − a program of reduction of adverse effects on the environment which result from the character of healthcare environments. It was initiated to encourage hospitals to improve their health and environmental impacts across six challenge areas: Leaner Energy, Less Waste, Engaged Leadership, Safer Chemicals, Smart Purchasing, and Healthier Food. In the period of 2012-2015 a three-year campaign: Healthier Hospitals Initiative (HHI) encouraged over 1.300 hospitals across the USA to join in, and was then transformed into Practice Green Health, a membership and networking organization for sustainable health care.

7. HEALTHY UNIVERSITY/ HEALTH-PROMOTING UNIVERSITY – A higher education institution involved in the sustainable development model lays particular emphasis on holistic health concept thereby making it 'an important aspect of everyday life, business practices, and academic careers, creating the campus culture of compassion, well-being and social justice as well as supporting sustainable development of the environment, social and economic life locally.

Other actions taken at MUL include: SMART UMED platform to support the functioning of users in the Green Campus of Didactic Centre through navigation of users, first certificates after the evaluation process for offices and units leading in implementing the values of sustainable development in everyday functioning, and scientific and research projects to solve health problems resulting from environmental pollution.

The examples provided above show that there are many different ways towards implementation of the Green Lab concept and that particular steps are largely affected by the conditions and occasions, in which the institutions exist as well as by their mission and internally-driven activities. Within A4L-consortium, there are several examples of good practice that are worth following.

Throughout the project, we learned that further stimulation of thoughts followed by actions can be achieved by calculation and regular follow up of the carbon footprint. Albeit it does not cover all facets of environmental burden, it respresent a standard indicator of the output of greenhouse gas emissions. The inventory of emissions is an essential part of creating a low-carbon strategy. It provides a clear picture of where the institute or the university stands in terms of the production of greenhouse gas emissions. The emission inventory focuses mainly on carbon dioxide – CO_2, because it is the most important gas of anthropogenic nature arising in key sectors of human activities. The equivalent emissions of carbon dioxide CO_2e reflect the impact of each of the six greenhouse gases covered by the Kyoto Protocol (CO_2, methane, nitrous oxide, HFC-fluorinated hydrocarbons (freons), SF6, PFC-perfluorohydrogens (freons) according to their contribution to global climate change. Although the **calculation of the carbon footprint** is voluntary for organizations, it is more than just a figure for greenhouse gas emissions. It **has an important strategic aspect and is beneficial for the climate and the environment, the economy as well as the reputation of the institution / university.** Therefore, we will embed this approach into the recently initiated A4L_BRIDGE project, which is a successor of the A4L_ACTIONS.

CONCLUSION

Introduction of environmental policy in the biomedical research (represented here by a Green Lab concept) is a very complex and pressing issue. Based on our preliminary experiences, we see several aspects to be addressed in order to facilitate its translation into real-life operations: strengthening awareness through learning and knowledge sharing, motivating researchers and research managers to transform existing practices into practices with reduced environmental footprints, and appealing on all stakeholders to provide support for implementation of transformative steps into daily life.

The primary goal is to build and reinforce awareness of environmental impacts of the research among research-governing bodies, institutions and researchers themselves, which is a key prerequisite for the next steps. With the accomplishment of A4L_ACTIONS project activities, we already succeeded in raising attention to this topic, increasing awareness and promoting knowledge of the topic in the partners' institutions. However, there is still a long way to go towards practical applications of this knowledge and we are dedicated to continue our efforts. Respect and protection of our environment is not just a matter of sustainability, but also of our eithical responsibility toward future generations.

ANNEX 1

Overview of the A4L_ACTIONS partners feedback to the survey questions. Reponses "Yes" are indicated by green color and are assigned value 1, responses "Partially" are indicated by light orange and are assigned value 0.5. Final score of the feedback to questions is the sum of values of all responses. (N.A. means not applicable).

GENERAL ASPECTS OF ENVIRONMENTAL POLICY	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
Is your institution aware of Green Lab strategy and EU Environment Policy?													10
Is your institution planning Green Lab strategy?													7,5
Is your institution implementing Green Lab strategy?													3
Is there a guideline on environmental policy/Green Lab strategy at your institution?													4,5
Is environmental training provided during new staff introduction?													5,5
Are annual update sessions on environmental management run?													5
Is there a personnel dedicated to environmental management / monitoring?													7
Is carbon footprint of your institution annually calculated and recorded?													4

PURCHASE AND SHARING OF EQUIPMENTS AND CONSUMABLES	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
Is equipment shared among research groups / departments?													6
Is equipment purchased based on requirements for most frequent use?													7,5
Are environmental benefits considered when making purchases? (e.g. energy star ratings, off switches, recirculated cooking water)													8
Is reusable equipment purchased where possible?													8
Do you consolidate purchases to reduce packaging waste?													5,5
Do you consolidate purchases in favor of recyclable plastic and/or plastic composed of recycled or compostable material?													4

RECYCLING	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
Is all waste paper in collected in paper bins and recycled?													11
Is packaging material recycled?													7,5
Is polystyrene recycled?													5
Are empty printer cartridges recycled?													10
Are mobile phones recycled?							N.A.	N.A.					7
Are batteries recycled? Is there a designated collection spot and do researchers know about it?													9
Is obsolete computer equipment recycled?													9,5
Is obsolete lab equipment recycled? (e.g. exchange, sale or auction)													8

ENERGY AND WATER	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
Have all incandescent lights been replaced with more efficient lighting?													8
Has a lighting audit been undertaken?													7
Are light switches programmed to turn off in empty areas?													7
Are hard drives and monitors (computers) switched off or on power save?													10
Are printers and photocopiers switched off when not in use?													11
Is the air conditioning switched off or on a sensor/timer?													10,5
Are fridges and freezers regularly cleaned out and consolidated?													9,5
Are there inventories of valuable frozen samples?													9,5
Are appliances run only when they have a full load? (e.g. autoclaves, glasswashers)													8,5
Are tissue culture hoods turned off completely when not in use? (with max 30 min UV sterilization if necessary)													10,5
Do you have water-saving program?													6
Do you established rules for efficient labware washing practices?													6
Do you share ice makers among research groups / departments?			N.A.										8
Do you share systems for distilled and purified water among research groups / departments?													8,5

CHEMICAL MANAGEMENT	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
Is there a guideline how to determine if a chemical can go down a sink?													8
Is there a guideline for the process of solid waste disposal?													9
Is there a guideline for chemical waste collection?													10
Are chemicals/reagents only ordered on an as needs basis?													8,5
Are chemicals/reagents shared with other research groups within departments?													6
Are chemicals/reagents shared with other departments?													5,5
Are Green Chemistry alternatives investigated when setting up experiments / projects?													4
Is a chemical tracking system used for the labs?													5

LABORATORY WASTE	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
Is animal waste disposed of correctly?													12
Is animal waste stored of correctly?													12
Is cell culture waste disposed of correctly?													12
Is there a guideline and special bins for biological non-infectious waste disposal?													11,5
Is there a guideline and special bins for biological cytotoxic waste disposal?													11
Is there a guideline and special bins for biological infectious waste disposal?							N.A.						11
Is there a guideline for biological GMO waste disposal?									N.A.				11
Are there persons taking care for emptying bins with laboratory waste?													12
Is there a guideline for radioactive waste disposal?	N.A.			N.A.									10

It has to be noted that the answers above apply to primarily research-oriented laboratories or departments. Diagnostic laboratories and departments (e.g. pathology and microbiology) which primarily perform diagnostic procedures have a different, more rigorous set of rules, which limit the use of green approaches. For research laboratories, strict set of rules are in place regarding the work with GMOs, animals, and radioactive reagents. **Work with GMOs** requires registration and approval by a special national committee or other entity responsible for GMOs. Laboratories are required to have special equipment (they need to be registered) and waste disposal is regulated. The level of regulation depends on the type of work performed. Similarly, only specially trained personnel, who passes the required training and examination, can **work with animals** and perform animal experiments. All animal experiments need to be approved by a special national ethics committee. Strict rules are in place for disposal of animal waste. Finally, as regards **work with radioactivity** ,different levels of training (with examination) are required depending on the type of work performed. Purchase and disposal of radioactive material is also regulated. **Disposal of chemicals** depends on the type of chemical. Some chemicals are collected and disposed in a regulated manner. This depends on the type and quantity of the chemical.