URBAN INNOVATIVE ACTIONS

APPLAUSE project

“Setting up a new circular approach to IAPS management in cities”

Zoom-In report 1 by UIA expert Jorgina Cuixart, February 2019

EUROPEAN UNION
European Regional Development Fund

UIA URBAN INNOVATIVE ACTIONS

Setting up a new circular approach to IAPS management in cities

REPORT OUTLINE

Introduction to IAPS and its impact on cities

The “traditional” linear approach to IAPS management vs. Ljubljana’s circular approach

Step 1 – Mapping out IAPS

Step 2 – Selecting the most appropriate IAPS for secondary use

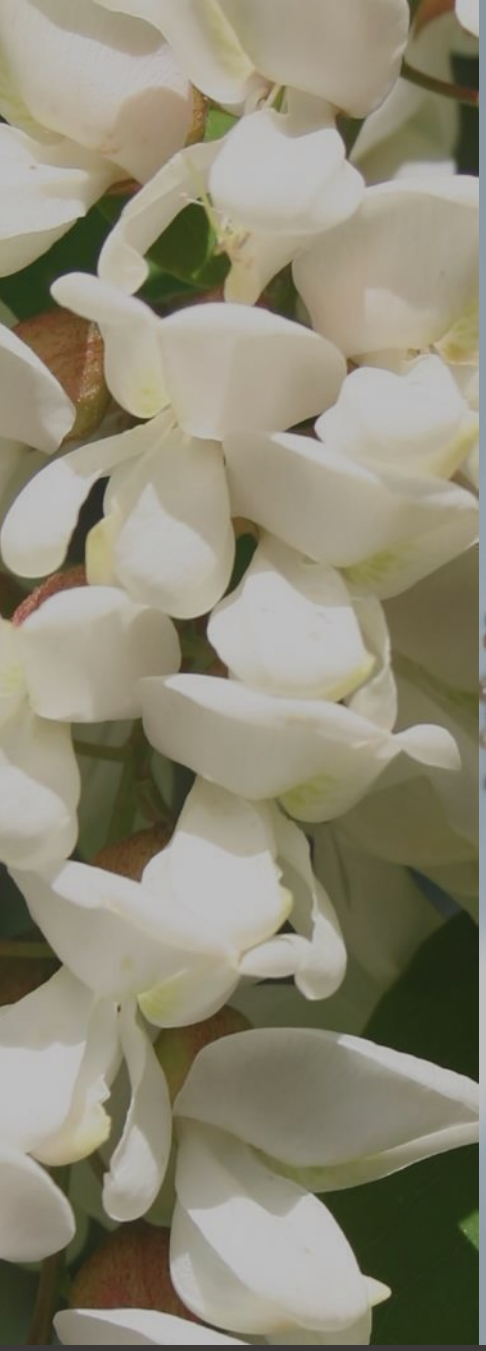
Step 3 – Organising the collection and pre-treatment

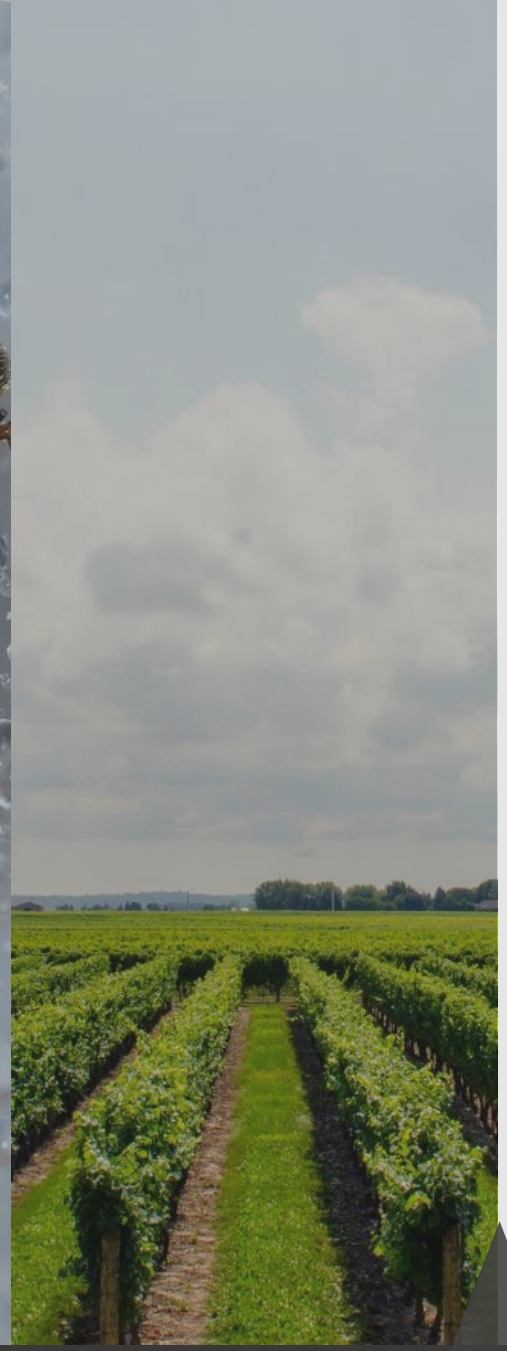
Conclusions and recommendations for other local authorities

INVASIVE ALIEN PLANT SPECIES (IAPS) ARE PLANTS THAT ARE INTRODUCED ACCIDENTALLY OR DELIBERATELY INTO A NATURAL ENVIRONMENT WHERE THEY ARE NOT NORMALLY FOUND, WITH SERIOUS NEGATIVE CONSEQUENCES FOR THEIR NEW ENVIRONMENT.

SOURCE: EUROPEAN COMMISSION

Japanese knotweed (*Fallopia japonica*)





Invasive alien plant and animal species are a well known problem for Europe, costing millions to the economy

Even if some introduced alien species can deliver benefits (economical or even environmental), the vast majority have harmful effects. According to the European Environmental Agency, the impact of IAS in Europe and the world is multifaceted. It can be classified in four major groups:

- Biodiversity
- Ecosystem services
- Human health
- Economic activities

While these impacts are often seen in rural areas or protected natural areas, it is also a problem for cities.

IAPS IMPACT ON CITIES

BIODIVERSITY

Replace local vegetation that is unique to the urban region by common non-natives

ECOSYSTEM SERVICES

Obstruct ecosystem services provided by urban green areas (e.g. floods and erosion prevention, climate change mitigation and adaptation)

HUMAN HEALTH

Act as vectors of human and/or animal diseases, causing toxicity and allergic reactions to citizens or pets

ECONOMY

Provoke structural damages to properties and to infrastructure leading to costly treatments

Impact on BIODIVERSITY

Canadian Goldenrod (*Solidago canadensis*)

Canadian Goldenrod is a perennial plant native to North America which has spread throughout a number of European countries.

It is characterised by large rhizomes and fast growth rate. It is also known to have allelopathic effects (production of biochemicals that influence the germination, growth, survival, and reproduction of other organisms). As a result, it is capable of eliminating all other plant species. Several studies also reveal a negative impact of goldenrod on bird species richness, diversity and/or abundance of butterflies, hoverflies, bumblebees, honeybees and carabid beetles.

Source: CABI and Dudek K. (Invasive Canadian goldenrod (Solidago canadensis L.) as a preferred foraging habitat for spiders)

Impact on ECOSYSTEM SERVICES

Japanese knotweed (*Fallopia japonica*)

Japanese knotweed is a herbaceous perennial plant native to East Asia. It is characterized by a strong rhizome system and a very fast growth pattern (up to 15 cm per day). Its high regenerative capacity makes treatment extremely difficult.

The rhizome system of knotweeds can seriously damage infrastructure, such as buildings, railway tracks and roads. It can also disrupt the integrity of flood defenses structures, increasing risk of flooding. Because aboveground plant parts die off, its monodominance leaves open grounds and provide increased danger to erosion.

Source: EEA Technical Report “The impacts of invasive alien species in Europe”

Impact on HUMAN HEALTH

Common ragweed (*Ambrosia artemisiifolia*)

The common ragweed is an annual herbaceous plant native from North America.

It is one of the most pollen allergenic plants, triggering hay fever, rhinoconjunctivitis or even severe asthma-like symptoms. Due to wind-borne spreading of the very large production of light pollen, allergy reactions are recorded in distances over 200 km from the site where the plant is situated.

In Italy, for example, the costs of human ragweed allergy have been calculated to amount to almost 2 mio € per year in the Milan province only.

Source: EEA Technical Report “The impacts of invasive alien species in Europe”

Impact on ECONOMY

Tree of heaven (*Ailanthus altissima*)

Tree of heaven is native from China. It was introduced to Europe in the 18th century for furniture and ornamental purposes. This plant is one of the fastest growing trees. It is a highly drought-resistant species, capable of surviving dry periods with its long root systems which also enable successful establishment on bare grounds in cities.

Growth close to buildings and at road embankments can cause serious economic costs due to damage to the infrastructure (cracks in street pavements or even in buildings). In Southern Europe, the extensive root system is known to harm historic and archaeological buildings.

Source: EEA Technical Report “The impacts of invasive alien species in Europe”

How do cities currently manage IAPS ?

Due to the harmful nature of these species, most IAPS cannot be composted, instead they are incinerated or sent to landfill. IAPS are managed in the “traditional” linear way.

Ljubljana’s innovative approach to IAPS management

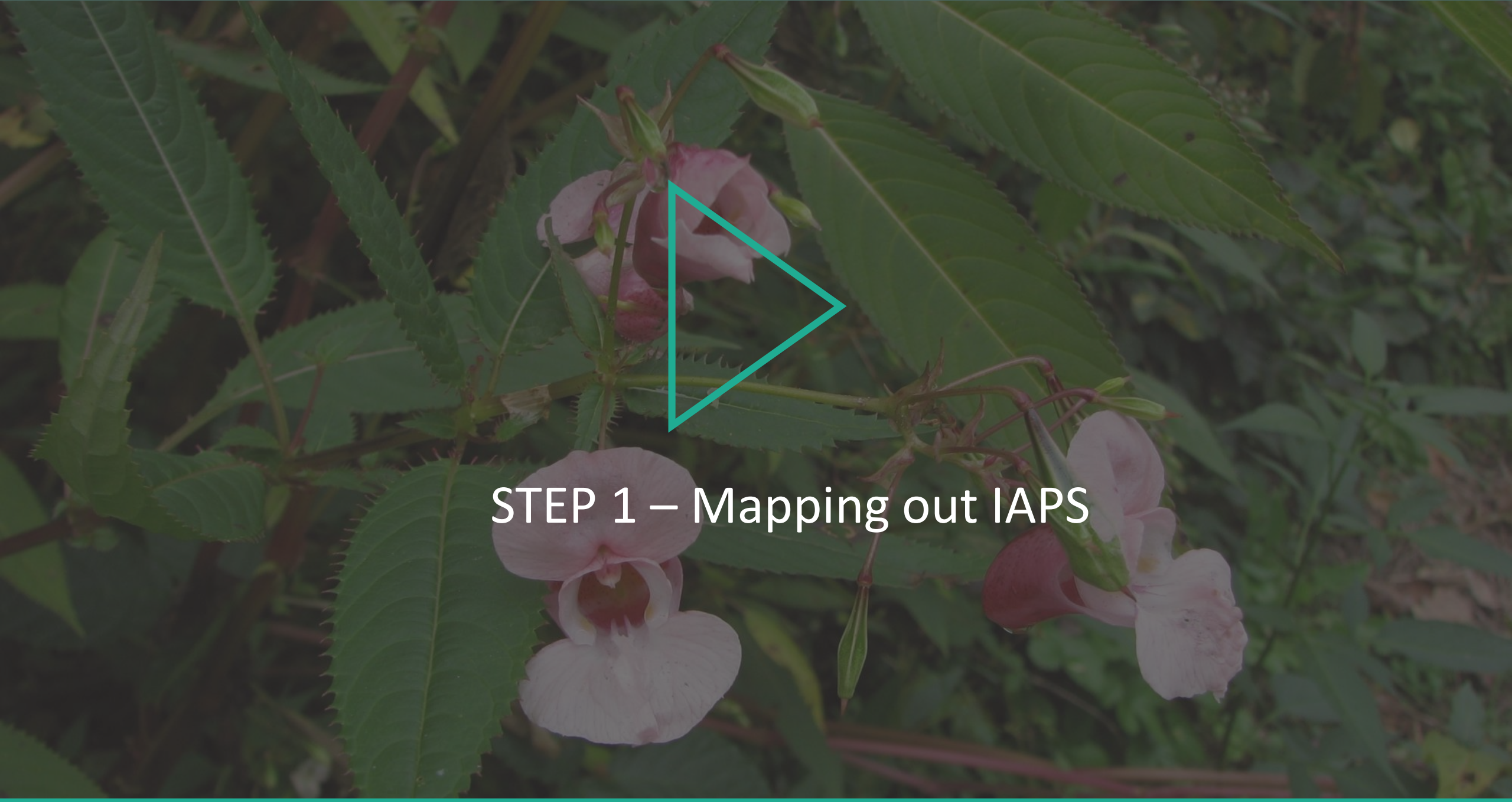
In APPLAUSE , Ljubljana experiments a completely new approach to IAPS management. Once collected, instead of sending it to incineration, they are considered as a resource and a starting point of a new circular business model.

IAPS SITUATION IN LJUBLJANA

- Around 20% of land in the City of Ljubljana is protected with natural environment status (Natura 2000 accounts for 13%).
- In the last field analysis (2015), 150 IAPS were identified in the city area.
- SNAGA, Ljubljana's public waste management company, is responsible for the management of public green areas in the city.
- Currently, IAPS are identified, collected and sent for disposal (some incinerated and some composted)
- Managing the public green areas costs approximately 3 mio € each year.

APPLAUSE APPROACH

- In a new circular approach, IAPS are considered raw material. Once pre-treated they can be used as input for new products (furniture, paper, biochemical compounds…).
- Focuses on 25 IAPS, chosen due to their widespread presence and/or potential for secondary use.
- IAPS are identified via field work and data from aerial photos and satellites. The IAPS material is harvested and pre-treated (e.g. wood cutting). Then it is sent to local agents who turn them into products.
- Citizens are invited to participate in each key step of the process.



STEP 1 – Mapping out IAPS

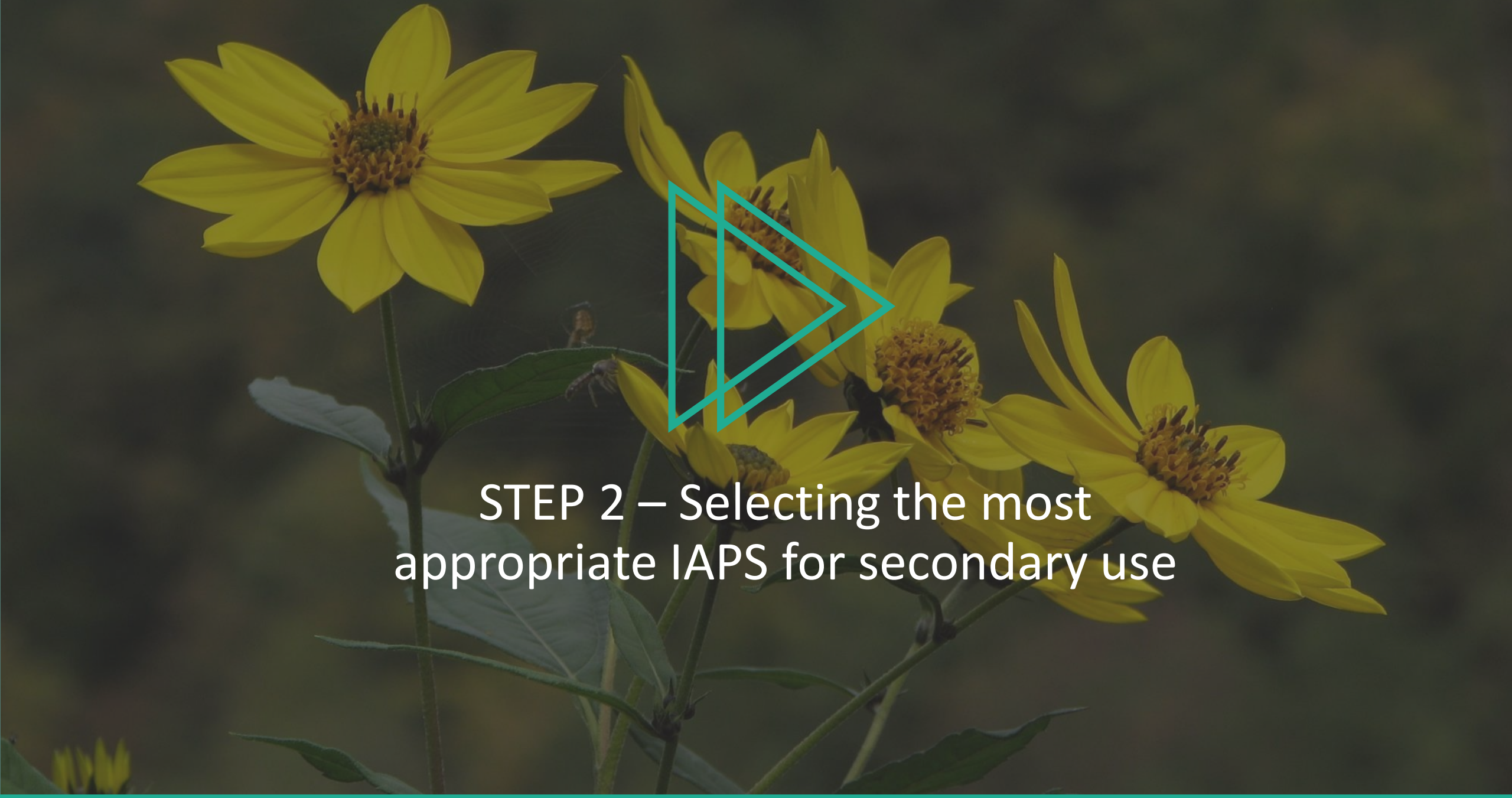
Ljubljana implements two methods to locate and track the IAPS present in its public green spaces:

- **Field work**: Botanists are tracking 25 IAPS. Field work is organised according to the growing seasons of the different species.
- **Using data from aerial photos and satellite**: A map of Japanese knotweed prevalence in Ljubljana has been created using automatic detection from aerial orthophotos. These photos have high spatial resolution but are only taken every couple of years (latest from 2018). To complement this, APPLAUSE partners are developing automatic detection from Sentinel satellite data, which has lower spatial but much better temporal resolution (images are available every 5 days). This allows them to explore spectral phenological characteristics of different IAPS species through time and improve their detection in urban environments.

MOVING FROM PAPER-BASED TO DIGITAL PRACTICES

To facilitate IAPS identification and tracking, APPLAUSE is developing a complete new set of digital tools aimed at professionals and citizens alike.

- ✓ Supports botanists during field work
- ✓ Uses Artificial Intelligence to help users to identify the correct IAPS
- ✓ It can be used by citizens to recognize and track IAPS wherever they are.
- ✓ In the future, it will be used as a management tool to process orders, organize collections of IAPS material, etc.



STEP 2 – Selecting the most appropriate IAPS for secondary use

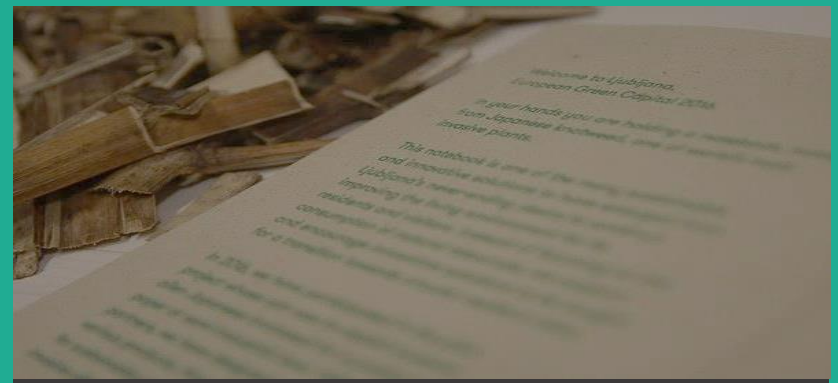
By harvesting different parts of the plants (flowers, stems, wood, rhizomes or leaves), Ljubljana is able to find new uses to IAPS recovered material:

- **Wood products** such as small carpentry items (tables, frames…) as well as heritage typography.
- **Craft paper products** as for example postcards, notebooks, calendars or packaging.
- **Dyes** that can be used to prepare formulations for printing on paper or textile substrates.
- **Organic pesticides** as an alternative to synthetic ones.
- **Biochemical compounds** to produce more eco-friendly coatings, adhesives, foams…
- **Biodegradable plastics** and composites of fibres, particles and/or resin.

How to analyse the suitability of different IAPS for secondary uses? Two examples

WOOD PRODUCTS

In-depth studies of each woody IAPS to identify the requirements of potential IAPS-based wood items



PAPER PRODUCTS

Chemical, mechanical, physical and morphological tests to evaluate the cost-effectiveness of paper production from IAPS raw material

Suitability of IAPS for processing into wood products

17 woody IAPS were studied at laboratory scale:

- **Anatomical studies**
- **Chemical analysis** of antimicrobial, antifungal and antioxidant properties
- **Physical and mechanical** tests to assess moisture, density, strength, elasticity, hardness…
- An assessment of **gluing and drying properties**
- Test of **durability** in laboratory and outdoor conditions
- **Thermal modifications** to measure mass loss, colour changes and energy consumptions
- **Wood-machining and fatigue** properties analysis
- Wood **liquefaction**

Results of the suitability tests of IAPS for processing into wood products

IAPS SELECTION

All 17 selected wood IAPS were anatomically investigated and chemically analyzed.

Based on harvesting, primary wood processing and determined relevant properties the 5 most suitable species for wood products were:

- Tree of heaven *(Ailanthus altissima)*
- Black locust *(Robinia pseudacacia*)
- Boxelder maple *(Acer negundo*)
- Honey locust *(Gleditsia triacanthos)*
- Horse chesnut *(Aesculus hippocastanum)*

CONCLUSIONS OF THE ANALYSIS

- All selected species are appropriate for conventional wood drying, *Robinia* needs more precise process monitoring.
- Thermal modification gives best results for *Ailanthus* and *Acer* and is not appropriate for *Robinia.*
- Products for outdoor use should be made of *Robinia* as most durable among all*, Robinia* also performed good in mechanical properties, gluing tests and surface planning.
- *Robinia, Acer and Aesculus* show good potential for liquefaction (percentage of liquefied wood in the final product were between 85% and 95%).

Suitability of IAPS for paper-making

7 IAPS were selected for analysis at laboratory scale:

- Initial **chemical tests** to find out the quantity of cellulose, hemicellulose, lignin and other substances. IAPS should contain minimum 35% of cellulose.
- A **delignification** process to remove lignin (an undesirable component in papermaking process) from IAPS to obtain pulp.
- **Mechanical tests** to verify drainability, stiffness, tearing resistance, air permeability…
- A study of the **fiber morphology** to assess fiber length and width, content of fine particles, curling, coarsness, fibrillation…

Results of the suitability tests of IAPS for paper production

IAPS SELECTION

7 IAPS analysed, 3 selected:

- Tree of heaven (*Ailanthus altissima*)
- Stag's-horn sumach (*Rhus typhina*)
- Black locust (*Robinia pseudacacia*) **- SELECTED**
- Canadian goldenrod (*Solidago canadensis*) **- SELECTED**
- Cutleaf coneflower (*Rudbeckia laciniata)*
- Japanese knotweed (*Fallopia japonica*) **- SELECTED**
- Bohemian knotweed (*Fallopia bohemica)*

CONCLUSIONS OF THE ANALYSIS

- All of them were suitable for pilot paper production but some where better than others.
- Black locust, Japanese knotweed and Canadian goldenrod met most of the requirements:
  - Highest percentage of cellulose fibers (at least 35%)
  - Low concentration of extractives and ash (< 10%)
- Other factors taken into account: availability of the biomass for continuous paper production, age of the biomass, time of harvesting, pre-treatment options…

STEP 3 – Organising the harvesting and pre-treatment

Three means of harvesting IAPS

MUNICIPAL COLLECTIONS

SNAGA, Ljubljana's municipal waste company and TISA, both partners in APPLAUSE, are very tightly included in IAPS management. They implement key activities related to the new circular approach:

- Receiving information from botanists on the location of different IAPS
- Planning collections according to the season and the type and amount of IAPS-material needed
- Pre-treatment of material (wood cutting, fresh leaves collection) within its premises
- Storage of the material until it gets delivered to pre-processor

CITIZENS' COLLECTION POINTS

A IAPS collection point has been set up within the Povšetova recycling and reuse centre.

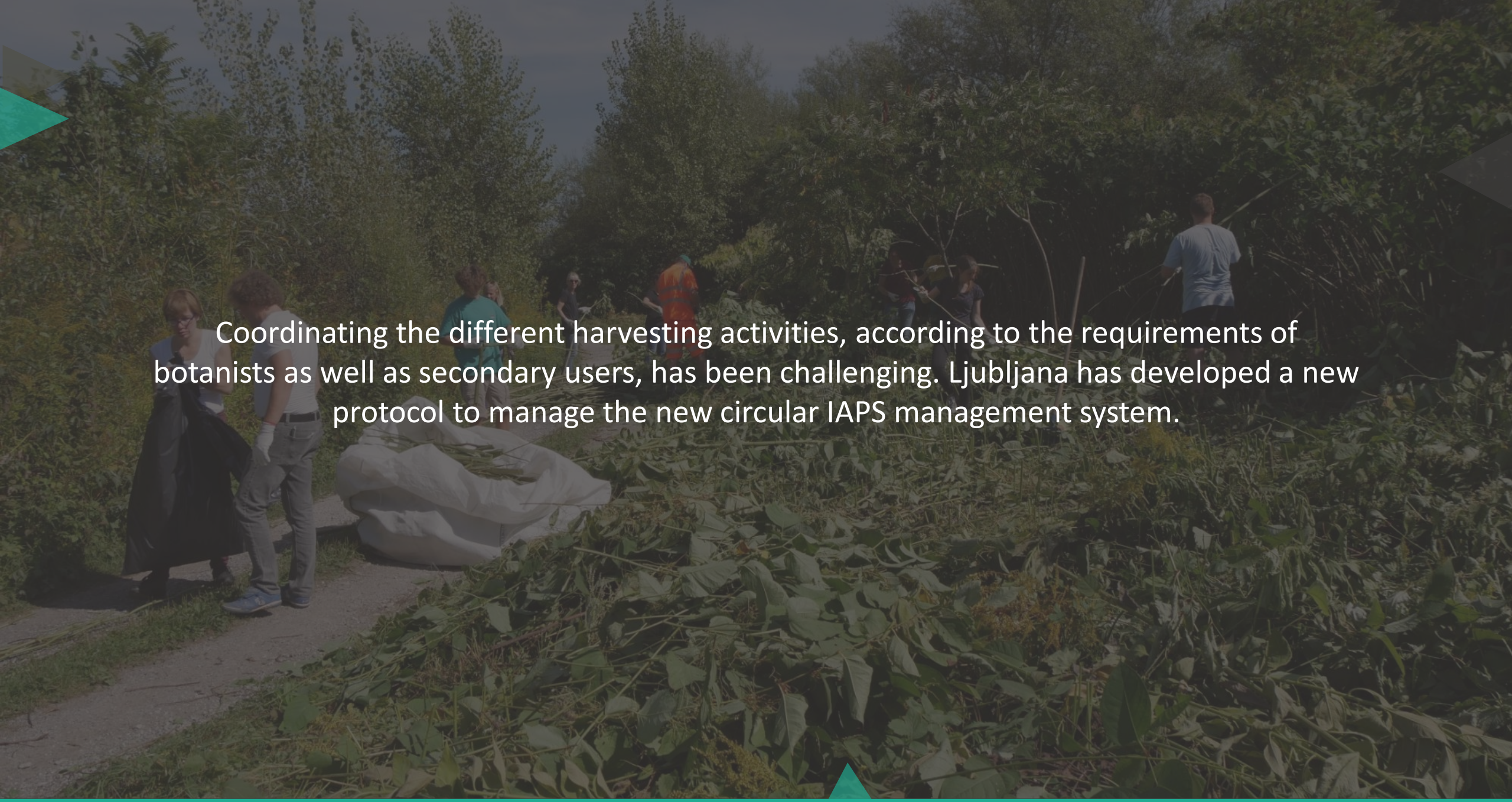
Citizens can hand over 11 different IAPS at the collection bins: Japanese knotweed, Bohemian knotweed, Canadian goldenrod, giant goldenrod, Thunberg's barberry, red-osier dogwood, Himalayan balsam (special protocol for handling), false indigo-bush, David's butterfly-bush, cherry laurel and Amur honeysuckle

A promotional campaign is being planned in spring time, coinciding with the beginning of the next growing season.

CITIZENS' COLLECTION CAMPAIGNS

A key aspect of APPLAUSE is to involve citizens in all steps of the circular process, from harvesting to production of new IAPS-based items. The workshops for paper and wood product development will be launched in May 2019. In the meantime, Ljubljana has already organised collection campaigns to recover raw material:

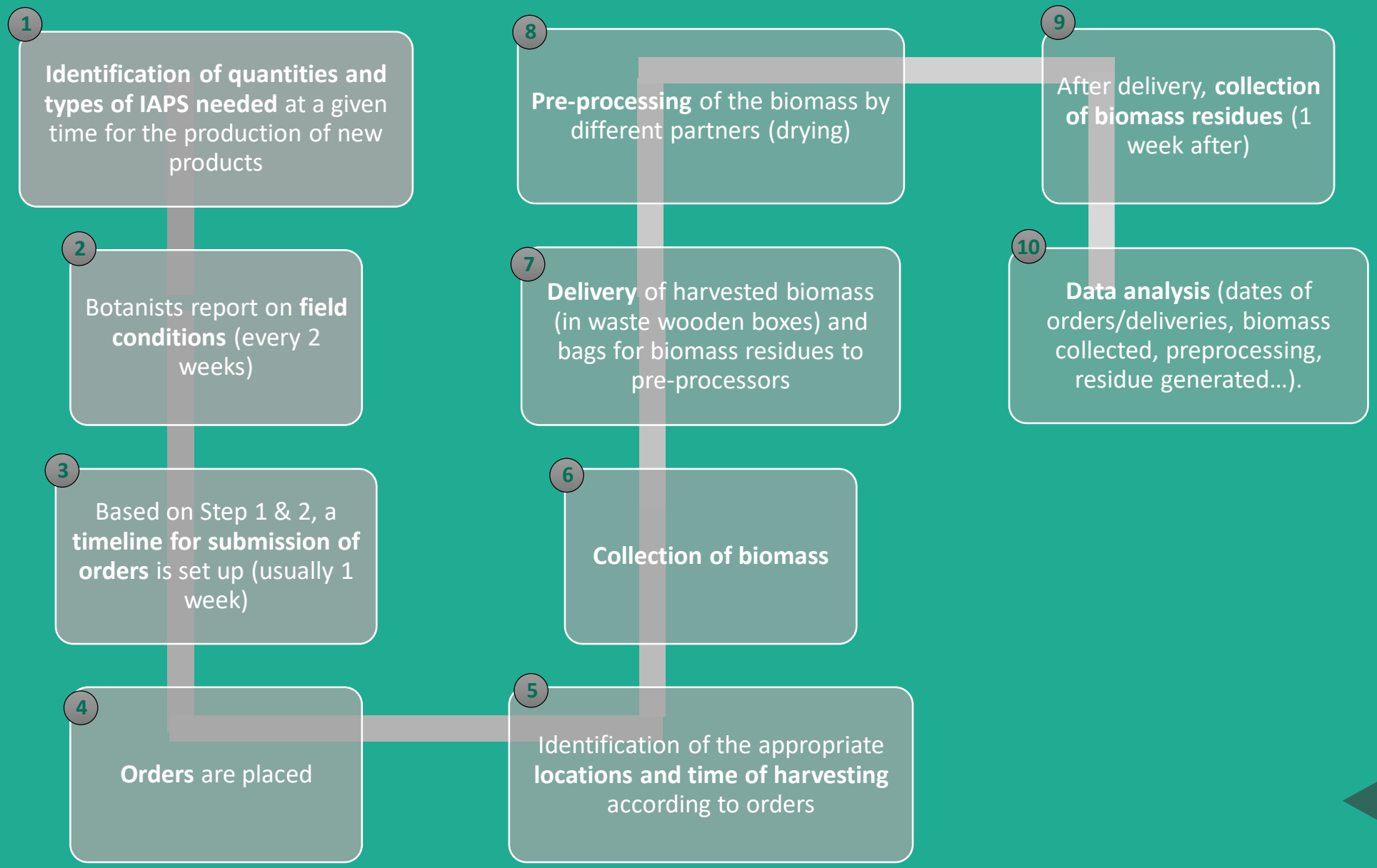
- 9 collection campaigns, with 140 participants in total. Most participants were active population, high school students or APPLAUSE project partners.
- In 2019, at least 30 additional campaigns are being planned.



Coordinating the different harvesting activities, according to the requirements of botanists as well as secondary users, has been challenging. Ljubljana has developed a new protocol to manage the new circular IAPS management system.

Protocol for herbaceous IAPS harvesting and pre-processing

Methodology developed and tested during the first year of APPLAUSE project



Conclusions of the first Zoom-in report

RECOMMENDATIONS FOR OTHER LOCAL AUTHORITIES

- Choosing the right timing for harvesting is crucial. It will depend on the growing patterns of each species and the part of the plant (wood, leaves, flowers) you aim to recover for secondary use. Expert advice from botanists is necessary.
- Be careful with storage, the pre-processed material can easily become moist or get contaminated with funghi.
- Digital tools (App, aerial photos) can assist you in IAPS tracking and monitoring. They represent a valuable upgrade of field work (save time and money for data collection).
- Assessing the suitability of IAPS for different uses requires thorough analysis. Ljubljana is getting support from local experts who are also partners in APPLAUSE.
- Organisation is key. Setting up a circular system requires coordination between the suppliers (in the case of Ljubljana they are SNAGA and TISA) and the producers of secondary materials. The process needs to be followed by all actors to ensure its viability in the future.
- Citizens can also play their part. Even if citizens will become more involved as the project develops, they can also take an active role in this initial stage. The collection points and the harvesting campaigns not only help in the recovery of IAPS material, they are also a means for raising awareness among Ljubljana's citizens.

Credits

ICONS AND IMAGES

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