RINNO PROJECT

Report

Transforming energy efficiency in European building stock through technology-enabled deep energy renovation

Deliverable 8.10: Exploitation Report and IPR Protection Plan (V1)
Work Package 8: Dissemination, Exploitation, Promotion & Knowledge Transfer

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Executive Summary

This document is an Initial Exploitation Report and IPR Protection Plan and is deliverable D8.10 of the RINNO project, an Innovation Action project supported by the European Union Horizon 2020 programme under Grant Agreement Number 892071. Full information on this project is available online at https://rinno-h2020.eu/.

This Initial Exploitation Report and IPR Protection Plan serves as the Strategic Guidelines for Exploitation for RINNO and outlines the activities the Consortium will take to maximise successful exploitation of the project deliverables.

This document aims to:

- Identify exploitation aims and priorities to help focus the efforts of the consortium as a whole.
- Outline the general IP management and knowledge protection policies of the Project.
- Present a commercial exploitation framework to support the Consortium's exploitation efforts and identification of commercial exploitation pathways.
- Present initial individual exploitation plans of academic and industry partners.
- Present key performance indicators for exploitation within the project.

This report is organised as follows. Section 1 introduces the RINNO project and its aims and objectives and key stakeholders, and outlines the objectives and aims for this report. Section 2 presents the general IP framework and knowledge protection policies of the project. The RINNO Commercial Exploitation Framework is outlined in Section 3. Section 4 outlines RINNOs the initial audience for the RINNO solution including segmentation, positioning and targeting as per the RINNO Dissemination and Communications Plan (D8.1). Section 4 also presents the features, advantages and benefits of the RINNO Suite. Section 5 presents an initial preliminary analysis of commercialisation factors associated with RINNO IPR. Section 6 outlines a summary of the Academic Exploitation activities expected during the project. Section 7 presents the preliminary individual exploitation plans of industry and academic partners. The report concludes with a summary of key performance indicators set for RINNO and actions to be taken in the coming months. A briefing note on commercialisation options is provided in Appendix A.

The strategy, plan and set of activities outlined in this document are by no means final. They are all subject to change to provide the project with a flexible approach to determine the most relevant routes to exploitation. Any changes to the plan will be presented in D8.11 (M36) and D8.12 (M48).

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Abbreviations List

IP	Intellectual Property
JOMA	Joint Ownership and Management Agreement
PoC	Proof-of-Concept
EIA	Environmental impact assessments
LCA	life cycle assessment
ISVs	Independent Software Vendors
TRL	Technology readiness levels
BIM	Building information modelling
TEA	Techno-Economic assessment
ESCOs	Energy Service Companies
EPC	Energy Performance Contracting
DCU	Dublin City University
NAPE	National Energy Conservation Agency
BIPV	Building Integrated Photovoltaics
EGC	European Green Cities
LMH	Lille Métropole Habitat
UNN	University of Northumbria Newcastle
BYCN	Bougyues Construction
REF	Research Excellence Framework
STOs	Security Token Offerings
TAO	Tokenised asset offering
M1	Month 1 of the project, May 2020
M12	Month 12 of the project, May 2021
M24	Month 24 of the project, May 2022
M25	Month 25 of the project, June 2022

M48	Month 48 of the project, May 2024

1. Introduction

1.1 Purpose of the Document

This document is an Initial Exploitation Report and IPR Protection Plan and is deliverable D8.10 of the RINNO project, an Innovation Action project supported by the European Union Horizon 2020 programme under Grant Agreement Number 892071. Full information on this project is available online at https://rinno-h2020.eu/.

The objectives of Work Package 8 as outlined in the original RINNO proposal include:

- Develop and implement a strategy for the individual and joint exploitation of the project;
- Openly and proactively disseminate and promote RINNO progress and results to a wide group of stakeholders;
- Raise awareness, build consensus, and create visible/measurable impact to exploit lessons learned and best practices based on the experience of RINNO;
- Implement an on-going assessment process to identify issues affecting RINNO's exploitation;
- Align, liaise and promote the activities of RINNO with standardisation bodies, European clusters and complementary initiatives at EU and International levels.

The overall objective of the exploitation plan is to contribute to maximising the impact of the RINNO project through the efficient management and exploitation of the knowledge produced by the project consortium. This will be achieved by:

- Detailing and assessing the market potential for the RINNO Suite and subordinate innovations that are developed as part of the project.
- Engaging with stakeholders to determine how the RINNO Suite and individual subordinate innovations can be exploited.
- Exploring the potential for individual subordinate innovations to be combined through collaboration between the RINNO Consortium and third parties.
- Identifying new revenue opportunities available through the exploitation of the RINNO outputs.
- Developing a strategy to sustainably exploit the results of the RINNO project.

1.2 Background

RINNO is funded under the European Union's Horizon 2020 research and innovation programme under the call H2020-LC-SC3-EE-2019. The RINNO consortium comprises of six academic partners, nine industry partners and four end users nine partners, and is coordinated by RINA Consulting (RINA-C) (see Table 1).

Table 1 List of RINNO Partners

Partner Institution	Country	Type
RINA-C	Italy	Industrial
CERTH-ITI	Greece	Academic
Regenera	Spain	Industrial
Circe	Spain	Academic
Ekolab	Denmark	Industrial
Avedøre Boligselskab	Denmark	End-user
European Green Cities	UK	Industrial
University of Northumbria at Newcastle	UK	Academic
University of Newcastle	UK	Academic
Bouygues Construction	France	Industrial
Lille Métropole Habitat	France	End-user
K-Flex	Poland	Industrial
VTT	Finland	Academic
Greenstruct	Greece	Industrial
HPHI	Greece	End-user
NAPE	Poland	End-user
PINK	Austria	Industrial
Motivian	Greece	Industrial
Dublin City University	Ireland	Academic

RINNO focuses on developing solutions for the construction industry to accelerate the rate of deep renovation in energy inefficient buildings around Europe, and thereby contribute to reaching the target of 32.5% cent in energy savings set by the EU Green New Deal. RINNO will achieve this through a combination of novel and innovative technologies, processes, and business models.

The solutions developed by RINNO will be demonstrated in four real-life renovation projects to quantify and validate their impact throughout the whole renovation process. The demonstration sites are located in France, Denmark, Greece and Poland, representing different EU climate zones and markets with varying maturity in the renovation sector.

1.3 Stakeholders

Table 2 and Table 3 below outline a preliminary overview of the general stakeholder landscape for exploitation, dissemination and concertation as initially identified in D8.1. These tables present the main categories of market and non-market stakeholders who can affect or be affected by the achievement of the objectives of the RINNO project. The primary focus of market stakeholders is to create value for their organisation to create value by directly participating in the market and improve the economic performance of their firm. In contrast, the primary focus of non-market stakeholders is the overall performance of all firms in the market or general market motivations (e.g., information dissemination).

Table 2 RINNO Primary Market Stakeholders

Stakeholder Code	Stakeholder	Description	Examples
ST1	Energy Solutions & Construction Technology Providers, and Independent Software Vendors (ISVs)	Energy Solutions & Construction Technology Providers, and ISVs develop and/or market their own energy efficiency solutions, construction technology or software solutions to housing development and construction companies and building owners. They have existing solutions that can be improved, extended, or complemented by RINNO outputs. They wish to add value to their existing solutions catalogue to generate incremental revenue.	**ST1A - Renewable technologies:** Amarenco (Ireland), BNRG Renewables (UK), Colloide (NI), Dow (US), FerroAmp (Sweden), Good Energy (UK). Kioto Solar (Austria), Next Kraftwerke (Germany), NIBE Energy Systems (Sweden), Oekostrom AG (Germany), Onyx (Spain), Pellini (Italy), Permasteelisa (Italy), Plastica (NL), Renewable Energy Generation (REG) plc (UK), SERGIES (France), Tempress Systems (NL), TULIPPS (NL), Vaillant (Germany), Valorem (France), Viasolis (Lithuania), WIP Renewable Energies (Germany) Sika, Trimo Group, Elements Europe (UK), Kingspan (Ireland & UK), Metawell (Germany). **ST1B - BIM, Digital Twin & Related Software Vendors:** ABB (SE), ANSYS, ASite (UK), Arup (UK), Autodesk (US), BeckTech (US), Bentley Systems (US), Bosch (DE), CADCAMation (FRA), CadSoft (CAN), Dassault Systemes (FR), Graphisoft (HU), IBM (US), IES (UK), Microsoft (US), Trimble (US).
ST2	Housing development and construction companies	Companies or businesses that are concerned with the	AG Real Estate (BE), Bonava (SE), Central Group (CZ), DOM

		development and construction of housing. They recommend, buy, license and use technologies and systems developed by third parties to deliver energy performance. They also include architects and specifically those who specialise or excel in sustainable architecture and Nearly Zero Energy Building (NZEB) design. They wish to differentiate themselves from competitors. They want to win more deep renovation projects and generate more profit from these projects while delivering better value for their clients.	Development (PL), Finep (CZ), Futureal (HU), HB Reavis (SV), JW Construction (PL), HB HINES (US), OHL (ES), OVG (NL), PEAB (SE), Skanska (SE), Strabag (DE), Tishman Speyer (US), YIT (FIN).
ST3	Architects	Architects design and plan the construction and renovation of built environments. They are responsible for delivering a built environment that is functional, safe, economical and increasingly sustainable. In deep renovation, architects need to understand the environmental performance of buildings, materials, systems and construction, considerations often	AART Architects (DEN), BEAR-ID (NL), BIQ Architecten (NL)., FORMAT D2 (FRA), Ines Camacho (BE), Hans van der Heijden (NL), Hauschil-Siegel (SE/DEN), Henley Halebrown (UK), Jakob + MacFarlane (FR), Karakusevic Carson Architects (UK), Lacaton et Vassal Architectes (FR), LAN Architecture (FR), Mikhail Riches (UK), Rolf Disch (DE), S333 Architecture (UK), Sean Harrington Architects (IE).

		beyond the normal sphere of the architectural design process (Chansomak & Vale, 2010). Given their role, they are a key influencer and liaison between various stakeholders in deep renovation projects. Architects buy, license and use a variety of software tools to model and design built environment projects including BIM and Digital Twinning software, and related databases, as well as various EIA, LCA, project management and collaboration tools.	
ST4	**Construction Finance Companies and Crowdfunding Platforms**	Construction finance companies provide finance for building and renovation projects. They wish to maximise their return on investment in building and renovation projects and generate an increased pipeline of investment opportunities at a lower cost of deal acquisition. Crowdfunding platforms are online intermediaries that match capital supply (investors) with capital demand (building owners or developers) in exchange for a fee. They may be owned by construction finance	**ST4A - Construction Finance:** Beacon Capital (IE), Housing Finance Agency (IE), IPUT PLC (IE), Triodos Bank (UK), European Investment Bank (EU), CBRE Global Investors, Legal & General (UK), Cyprus Land Development Corporation (CY), BNP Paribas (FR), Aviva (UK), M&G (Prudential), Standard Life (UK), Blackstone Capital (IE), Instituto de Credito Oficial (ES). **ST4B - Crowdfunding Platforms:** Abundance, Conda, Green Crowd, Lumo, OnePlanet Crowd, Sunfunder, Crowdproperty (UK), CrowdLords (UK), Walliance (IT), Urbanitae (ES), PropCrowd (ES),

		companies and investors. They have existing financing mechanisms and platforms that can be improved, extended, or complemented by RINNO outputs. They wish to add functionalities and value to their existing platform to generate incremental revenue and increase access to finance and placement to funds.	FundingOptions (UK), Crowd Real Estate (NL), Triodos Bank (UK).
ST5	Building owners	These include, but are not limited to, companies, municipal and local authorities, and individuals who have an ownership interest in any private or public building. They want to renovate their building stock cost efficiently while at the same time minimizing disturbance to occupants and overall renovation time. They want to increase energy efficiency and environmental performance to meet or exceed national standards, meet European goals, and maximise occupant satisfaction. They want to leverage new sources of financing to fund renovation projects.	**ST5A - Individual owners** **ST5B - Social Housing and other landlords:** ATC Piemonte Centrale (Italy), CASA SPA (Italy), Deutsche Wohnen (DE), Habitat 76 (France), Heimstaden (SE), LUDVIKAHEM AB (Sweden), GECINA (FRA), NCORE (US), Paris Habitat (FR), SAGA (DE), Sanctuary Housing (UK), SLRB Brussels (BE), SNI Group (FR), Stadt Wien (AT), Svenska Bostader (SE), VESTIA (NL), Vilogia (FRA), Visesa (ES), Vonovia (DE), Wheatley Group (UK).

Table 3 RINNO Secondary and Non-Market Stakeholders

Stakeholder Code	Stakeholder	Description	Examples
ST6	**End Users**	An End User is the person for whom a product is designed. In the context of RINNO use cases, they are typically construction workers, energy auditors or other deep renovation specialists involved in the renovation of building stock, are delivery or management of building energy performance. They use RINNO solutions in their day to day activities, and are measured by the quality of their work, and the time, effort, and associated cost to meet required specifications. They do not have a lot of time for training and new skills need to make them more attractive to the jobs market and safety in their tenure.	**ST6A - BIM Software** – Architects, BIM Managers, Director of Virtual Design/Construction, Facility Manager, Planners. **ST6B - Digital Twin** - Energy Officer, Building Physics Engineer, Sustainable Structures and Materials Specialist, Building Simulation Specialist, Sustainability/Energy Engineer Energy Assessor, BREEAM Specialists/Professionals, Building Services Design Consultants. **ST6C - Associations:** Chartered Institute of Architectural Technologists, Association of European Experts in Building and Construction, Irish Green Building Council, The Chartered Institute of Building, Build Europe.
ST7	**Occupant**	An Occupant is a person who resides in the building being renovated. Most want best value for money energy performance. Some want to meet reduce environmental impact and meet or exceed international standards for energy performance.	**ST7A - Individuals, Tenants** **ST7B - Associations:** Confédération Nationale du Logement (FR), Federació d'Associacions de Veïns d'Habitatge Social de Catalunya (ES), International Union of Tenants, Lejernes Landsorganisation (DEN), Mietervereinigung Österreich (AT), National Federation of Tenant Management Organisations Ltd (UK), Sindicato Inquilini Casa e Territoria (SICET) (IT), Polskie Zrzeszenie

			Lokatorów (PL), Vuokralaiset (FI).
ST8	**Research Centres and Projects**	Research projects and dedicated research centres attract government and industry funding to carry on research aiming to push the technology boundaries of existing solutions, to identify economic and business impacts of novel solutions or to foster the industry adoption of novel technologies and processes. They typically focus on specific elements of the renovation lifecycle, operate within pre-defined boundaries, and aim to influence a large number of stakeholders.	**ST8A - Renewable Materials & Technologies:** Armines (FR), AZEB, BESTRES, BIFACE, CREATE, EnergyMatching, HVACviaFACADE*, GIGATES, Passive House Institute (DE), SCORES, BIOFIT. **ST8B - Crowdfunding/Business Models:** CitizEnergy, CrowdFundRes, CityNVest, European Crowdfunding Network AISBL (ECN), PV Financing, WISEPower **ST8C - Research Centres:** Buildings Performance Institute Europe (BE), WIP Renewable Energies, International Solar Energy Research Center Konstanz (DE), Centro Nacional de Energías Renovables (ES), AEE – Institute for Sustainable Technologies (AT), MaREI (IE), JRC Joint Research Centre (IT), IVL Swedish Environmental Research Institute (SE), Eurac Research (CH), FOSS Research Centre for Sustainable Energy (CY).
ST9	**Investors and Licensors**	These are individuals or organisations that invest or license technology and other research outputs for commercial purposes.	GV, M12 (Microsoft Ventures), Cisco Investments, Intel Capital, Intellectual, Ventures, Horizons Ventures, Breakthrough Energy Ventures, Building Ventures, Statkraft Ventures, Arup Ventures
ST10	**EU Institutions, Policymakers, and Funding Bodies**	These are persons or organisations that formulate or influence policy in EU institutions, national and local government and include regulators,	European Commission, European Council, Member State Governments, Municipal and local authorities, Chambers of

		international bodies, and other political bodies. Funding bodies are organisations that provide funding for industrial or academic research. They may operate at a national or international level and include philanthropic, private sector and public sector organisations.	Commerce, Enterprise Ireland, SFI, ESRC, etc.
ST11	**NGOs (incl. environmental organisations)**	An NGO is an organisation that is independent of government involvement. NGOs are a subgroup of organisations founded by citizens, which include clubs and associations which provide services to its members and others. RINNO is particularly relevant to environmental organisations – NGOs who aim to protect, analyse or monitor the environment against misuse or degradation from human forces.	European Climate Foundation, European Crowdfunding Network, EEB, ECOS, European Environment Agency, INFORSE, ECEE, Climate Alliance, Climate Action Network, International Energy Foundation
ST12	**Industry associations**	An organisation founded by and funded by businesses that operate in a specific industry. They aim to represent the interests of their members, establish best practices, industry leadership or the technical standards to which their members should adhere to.	**ST12A - Construction:** Architects Council of Europe, European International Contractors, European Council of Civil Engineers, European Union of Developers and House Builders, European Construction Industry Federation, Construction Industry Council **ST12B - Building Owners:** Building Owners and Managers Association, Confederazione Italiana della Proprietà Edilizia (Confedilizia)(IT), European Property Federation (EPF), Zentralverband der Hausbesitzer (AT), Irish Property Owners Association (IPOA), National Landlords Association (NLA), Syndicat National des Propriétaires a Copropriétaires (SNP-

			AES)(BE), Union Nationale de la Propriété Immobilière (UNPI)(FR), Hellenic Property Federation (POMIDA)(GR) **ST12C - BIM:** A2, BIMForum, BIM Journal, BuildingSMART, CAD User Magazine, The CAD Society, CAD Evangelist, Construction Computing Magazine, Construction Magazine, Develop3D **ST12D - Renewable Energy and Technologies:** European Solar Thermal Industry Federation (ESTIF), Solar Power Europe
ST13	**Standardisation bodies**	A Standardisation Organisation develops, coordinates, issues and maintains standards intended to address the needs of a group of adopters. Standardisation Organisations are consensus-building bodies comprising individuals and organisations. They can be categorised by their role, position, and the extent of their influence on the local, national, regional, and global standardisation arena.	IEEE, ISO, ETSI, NSAI, CEN, CENELEC, EPBD, LiCEA, EED, RED, Eco Design Directive, Ecodesign and Energy Labelling, ESTIF, SEAI.
ST14	**Media and Industry Analysts**	The media includes formal and informal communication outlets that create content to influence stakeholders. These include the broader general media outlets (e.g. national newspapers) and specific technical or scientific outlets. Similarly, an Industry Analyst performs primary and secondary market research within an industry such as information technology, telecommunications etc.	**ST14A - Construction & Architecture:** Architectural Digest, Architectural Record, Architectural Review, The Architects Newspaper. **ST14B - BIM Software:** AEC Bytes, AEC Magazine, AEC DevBlog, Architectural CGI. **ST14C - Renewable Energy Solutions:** Ecozen, Energy Live News, Construction News, Recharge News, Energy industry today, Sustainable Building.

	ST14D - General ICT: Computer Weekly, Silicon Republic, Tech Central. **ST14E - Mass Media and Other:** The Irish Times, The Greek Reporter Europe, La Repubblica. **ST14F** - Allied Markets, Gartner, Glenigan, GMI, IBIS, IDC, Technavio

2. General IP Management and Knowledge Protection

The RINNO Project Coordinator is responsible for the overall IP management and knowledge protection and will be assisted by the Exploitation Manager (DCU) and Dissemination & Communication Manager (DCU).

Confidentiality	All information provided by a partner to other partners within the project is confidential unless it was already known to the partner before the negotiations started, or the information provided is public property, or it is explicitly specified otherwise by the originator of the information.
Existing IP	All partners are the exclusive owners of any tools, data and information held prior to this project, as well as copyrights or other intellectual property rights pertaining to such information.
Access Rights/Use	All partners will grant access to their background knowledge to other partners on a royalty-free basis, unless otherwise agreed, if needed by the requesting partner for performing the project tasks. Partners have agreed to use the information provided only for the purposes of conducting the project. Any disclosure of confidential information to a third party requires the explicit consent of the originator of that information.
Ownership	As a general rule, solely generated IP will be solely owned by the generating partner and jointly generated IP will be jointly owned pro-rata based on the relative intellectual contribution of each partner. In such cases, a separate Joint Ownership and Management Agreement (JOMA) will be signed by the partners concerned.
Protection	The owning partner(s) will decide on the ways in which they wish to protect the newly generated knowledge (foreground).
Dissemination	Partners are requested to give prior notice of any planned publication 30 days before the dissemination or publication of project results to all other partners. Objections will be handled according to the conflict resolution process.

3. Commercial Exploitation Framework

The following exploitation framework has been designed to support the RINNO Exploitation efforts.

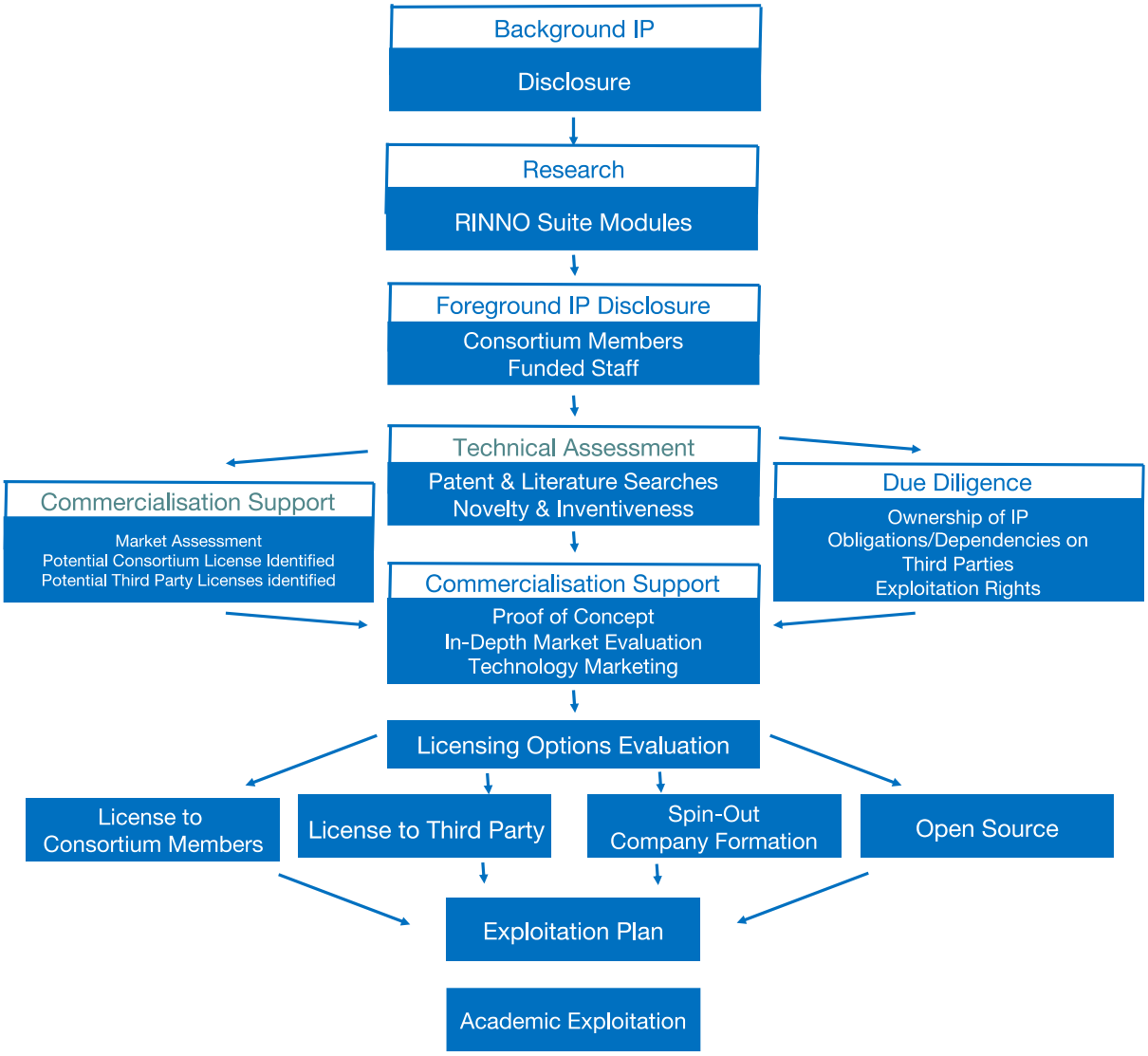

Figure 1 RINNO Exploitation Framework

3.1 Background IP

The management of knowledge, intellectual property, and innovation, including exploitation of results, is regulated by the RINNO Consortium Agreement. As per the document, the project consortium has agreed on the following:

- All information provided by a partner to other partners within the project is confidential unless (i) it was already known to the partner before the negotiations started, or (ii) the information provided is public property, or (iii) it is explicitly specified otherwise by the originator of the information.
- Partners agree to use the information provided only for the purposes of conducting the project. Any disclosure of confidential information to a third party requires the explicit consent of the originator of that information.

- Proper records, indicating the originator and the date of the transfer, must be kept when information is transferred between partners. When more than one partner claims joint ownership of newly produced IP, the partners involved should make provisions to clarify the terms of joint ownership among them. Partners are not restricted in any sense regarding the rights associated with the ownership of any IP they produce while conducting the project activities.

3.2 Research

The RINNO project comprises of two primary categories of exploitable resources – (i) the RINNO Suite as an integrated system and (ii) subordinate innovations. It is envisaged that RINNO will progress the majority of individual subordinate innovations within the project to TRL 7-9 by M48, as per the Horizon 2020 Work Programme Scale[1]:

Table 4 Current and Expected TRLs of the Project IP Contributions

Item No.	Key Exploitable Results	Type	TRL at M1	TRL at M48
1	**Plug-n-Play Modular Building Envelope Elements**			
1.1	Bio-based double layer panels	Product	7	9
1.2	Bio-based pipes and sheets	Product	7	9
1.3	Isocell Cellulose Insulation	Product	8	9
1.4	Thermochromic Glass	Product	8	9
2	**RES Harvesting and Hybrid Solutions**			
2.1	K-BOX bio-based insulating system for parts of energy systems	Product	7	9
2.2	Climate Cover PV -Roof and -Facade solutions	Product	8	9
2.3	MicroVent sustainable Ventilation system	Product	8	9
2.4	Building Integrated Photovoltaic Glass	Product	8	9
3	**De-centralized domestic hot water preparation**			
3.1	Wall integrated storage tank	Product	7	9
3.2	Wall mounted storage tank	Product	8	9
3.3	Electrical charging system	Product	6	9
3.4	Electrical control system	Product	7	9
3.5	Hydraulic charging system	Product	7	9
3.6	Hydraulic control system	Product	7	9
3.7	Prefabricated hydraulic module	Product	8	9
3.8	Biobased Insulation	Product	5	7
4	**RINNO Planning & Design Assistant**			
4.1	Immersive Building Capturing & Mapping	Software	5	7
4.2	Digital Twin toolkit	Software	5	6
4.3	Renovation Simulation & Assessment Toolbox, which includes:			
4.3.1	Energy Assessment Toolkit (INTEMA)	Software	5	8

[1] https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

4.3.2	Environmental, Cost and Social Assessment Toolkit	Software	5	8/9
4.3.3	Techno-economical Assessment Toolkit	Software	5	8/9
4.3.4	Renovation Optimizer & Planner	Software	4	8
5	**RINNO Retrofit Manager**			
5.1	Recommendation Engine for Industrialized Retrofitting	Software	5	7
5.2	Logistics & Process Optimization Tool	Software	5	7
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	Software	5	7
5.4	On-the-job AR facilitating environment	Software	5	7
5.5	Retrofitting Process Manager	Software	5	8/9
6	**RINNO Building Lifecycle Renovation Manager**			
6.1	Multi-Purpose IoT-Enabled Building Monitoring	Software	5	8/9
6.2	Renovation Validation and Benchmarking Tool	Software	5	8
6.3	Renovation Marketplace and Social Collaboration Platform	Software	5	8
6.4	Building Renovation Passports and Logbook	Software	1	3
7	**Renovation Workflow and Transaction Manager**	**Software**	**5**	**9**
8	**Business Models**			
8.1	Deep renovation Business Models Guidelines	Guidelines	7	9
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	Guidelines	8	9

3.3 Foreground IP Disclosure

As a general rule, solely generated IP will be solely owned by the generating partner and jointly generated IP will be jointly owned pro-rata based on the relative intellectual contribution of each partner. In such cases, a separate Joint Ownership and Management Agreement (JOMA) will be negotiated, agreed, and signed by the partners concerned. In line with the general RINNO policy, the owning partner(s) will decide on the ways in which they wish to protect the newly generated knowledge (foreground).

Once a deliverable has been completed, generating partner(s) should disclose this IP to the Exploitation Manager (DCU) and Dissemination & Communication Manager (DCU) who will record ownership.

3.4 Due Diligence

DCU will confirm and record ownership of the IP and ensure any separate Joint Ownership and Management Agreements have been completed. DCU will work with the generating partner(s) to identify and record any third-party obligations and dependencies and assess risk associated with such obligations and dependencies. A discrete exercise will be undertaken to assess the impact on the exploitation potential for the RINNO Suite and other subordinate innovations. Exploitation rights will be identified and confirmed.

3.5 Technical Assessment

It is envisaged that each consortium partner will be responsible for the technical assessment of IP generated within the project and any associated IPR and patent activities. External IP protection specialists will be engaged where deemed appropriate in consultation with the generating partner(s), the RINNO Coordinator and the wider consortium.

3.6 Commercial Assessment

Commercial exploitation requires having a deep knowledge of the industry segments in which RINNO operates, the sub-segments in which the RINNO Suite or subordinate innovations will be positioned and the end user requirements. The RINNO consortium will collate this knowledge in two primary ways:

I. Desk Research (January 2022 - Onwards). RINNO have identified an indicative list of industry analysts in the target industries and sub-segments, including but not limited to Allied Markets, Gartner, Glenigan, GMI, IBIS, IDC, Technavio (ST14F). Industry projections, forecasts and end user surveys will be reviewed, summarised and compiled into market briefings.
II. Primary Research (January 2022 – Onwards). The goal of the RINNO primary research is to understand in general terms for each of the use cases:
    - What is 'the job/task to be done'?
    - What are the needs of target customers, end users and associated organisations, their challenges/problems and which ones are worth addressing/solving?
    - What are the micro-foundations of decisions to invest in energy saving technology?
    - Who are their stakeholders and market influencers?
    - What are the key stakeholder needs and required outcomes and how do they measure these in terms of value/ impact?

An online survey with a target of 130 responses will be used to answer these questions and may be supplemented with interviews.

In addition, DCU will compile a database of potential licensors and engage with them and their licensing/business development representatives to understand their licensing process, their needs and interest in RINNO innovations. These contacts will be used in the Commercialisation Support activities listed in Section 3.7 below.

3.7 Commercialisation Support

The design, development and delivery of the RINNO Suite proof-of-concept (PoC) and subordinate innovations represents a significant dependency in the commercial assessment of RINNO foreground IP. Notwithstanding this, a key activity in commercialisation support includes validating and verifying the product-solution fit and the solution-market fit of the RINNO Suite PoC and subordinate innovations

based on the Commercial Assessment, as appropriate. Given the scale and scope of technologies being developed in RINNO, individual partners will be tasked with undertaking preliminary market analysis for their respective IPR. DCU will support individual partners, where feasible and appropriate, and integrate such analysis into RINNO exploitation, dissemination and concertation plans.

In addition, DCU will prepare marketing materials to support the RINNO Suite PoC as per Table 5.

Table 5 Exploitation Collateral and Marketing Tools

Collateral and Marketing Tools	Description
Fact Sheet	A professionally printed data sheet describing the foreground IP and outlining features and benefits in agreed languages targeted at licensors.
PowerPoint Presentation	A PowerPoint presentation tailored for the Foreground IP will be developed targeted at licensors including primary market and end user research.
Video	A short 3-5 minute video demonstrating the PoC.

3.8 Commercialisation Options Evaluations

A major part of Task 8.3 will be end user and expert engagement to identify and detail commercialisation options. A framework based on Penin (2010) will be used to guide the options assessment comprising four commercialisations factors - the nature of the innovation, technological regime, competition regime and target licensees. The nature of the innovation is based on the anticipated technology outputs and technology readiness level assessments reported by the RINNO consortium partners. The technological regime and competition regime will be supported by desk and primary research. Preliminary analysis of commercialisation factors is provided in Section 5. A briefing note on commercialisation options is provided in Appendix A.

3.9 Exploitation Plans

Based on the activities completed in Sections 3.7 and 3.8, a detailed exploitation report and appropriate post-project strategy will be put in place for recommendation to the consortium. In the event that the consortium chooses to jointly exploit the RINNO Suite, this will include a market assessment, technology overview, exploitation strategy, go to market plan, risk assessment, and illustrated financial illustrations for the exploitation of the RINNO Suite, as appropriate.

4. Primary Commercial Segmentation, Targeting, and Positioning

This section recaps the commercial segmentation, targeting and positioning for the RINNO project as detailed in D8.1 and expanded in D8.2.

4.1 Who are our customers?

RINNO primarily delivers value to (i) energy solutions & construction technology providers and related Independent Software Vendors (ISVs), (ii) housing developers and construction companies, (iii) sustainable architects, (iv) construction finance companies, and (v) building owners. Overall, the proposed RINNO solution focuses on European residential building stock constructed before 1990, while other geographic markets, for example, the Asian-Pacific market, will also be examined as part of exploitation research during RINNO.

Energy Solutions & Construction Technology Providers, and ISVs:

- Develop and market technologies including renewable materials, equipment, and complementary technologies for supporting and delivering residential deep renovation projects, including building components or complete building envelope solutions and renewable energy harvesting and storage technologies.
- Develop and market software solutions for building information modelling, deep renovation process management, building and infrastructure management and maintenance, and/or related technology management.
- Wish to improve, extend, or complement their existing product/service offering in a cost-effective way, increase competitiveness through these new value-added products and services, and generate incremental revenues with comparatively little upfront R&D investment.

Table 6 Illustrative Target Companies for RINNO Exploitation (Energy Solutions & Construction Technology Providers, and ISVs)

Region	Sub-segment	Indicative Companies
Europe	Energy Solutions & Construction Technology Providers	Colloide (NI), Elements Europe (UK), Kingspan (Ireland & UK), Kioto Solar (AT), Next Kraftwerke (DE), NIBE Energy Systems (SE), Oekostrom AG (DE), Onyx (ES), Pellini (IT), Permasteelisa (IT), Plastica (NL), Tempress Systems (NL), TULIPPS (NL), Trimo Group (SV), Vaillant (DE), Valorem (FR), Viasolis (LT)
	ISVs	ABB (SE), ASite (UK), Arup (UK), Bosch (DE), CADCAMation (FRA), Dassault Systemes (FR), Graphisoft (HU), IES (UK)
Rest of World	Energy Solutions & Construction Technology Providers	Dow (US), ORMAT Technologies (US), TRIVA (US), RES Group (CA), Acciona (CA), Tetra Tech (CA), BT Energy (AU), Electronet (NZ)
	ISVs	ANSYS (US), Autodesk (US), BeckTech (US), Bentley Systems (US), CADSoft (Canada), IBM (US), Microsoft (US), Trimble (US)

Housing Developers & Construction Companies:

- Buy, license, and use technologies, and systems developed by third parties to deliver energy performance.
- Wish to differentiate themselves from competitors by providing superior services and buildings.
- Aim to win more deep renovation projects and generate more profit from these projects while delivering better performance and value for their clients.

In many instances, housing developers and construction companies may own or manage the properties they develop in their own right or on behalf of the ultimate owner. In such instances, profitability and occupant satisfaction may have greater importance.

Table 7 Illustrative Target Companies for RINNO Exploitation (Housing Developers & Construction Companies)

Region	Indicative Companies
Europe	ACS (ES), AG Real Estate (BE), Balfour Beatty (UK), Bonava (SE), Central Group (CZ), DOM Development (PL), Durkan (IE), Eiffage (FR), Finep (CZ), Futureal (HU), HB Reavis (SV), JW Construction (PL), Hochtief (DE), Mullaley (UK), OHL (ES), OVG (NL), PEAB (SE), Skanska (SE), Strabag (AT), Vinci (FR), YIT (FIN)
Rest of World	AECOM (US), BlackRock (US), BMD (AUS), China State Construction (PRC), Hines (US), LendLease (US), Suffolk Construction (US), Sidewalk Labs (US), Tishman Speyer (US),

Sustainable Architects:

- Design and plan the renovation and construction of sustainable built environments.
- Require specific skills and knowledge for gathering environmental and cultural considerations, both pre- and post-occupancy, as well as specific sustainable design techniques and tools including environmental impact assessments (EIA), life cycle assessment (LCA), building rating systems (e.g., LEAD and BREEAM), standards, and environmental regulations (Chansomak & Vale, 2010).
- Buy, license and use a variety of software tools to model and design built environment projects including BIM and Digital Twinning software, and related databases, as well as various EIA, LCA, project management and collaboration tools.

Table 8 Illustrative Target Companies for RINNO Exploitation (Sustainable Architects)

Region	Indicative Companies
Europe	AART Architects (DEN), BEAR-ID (NL), BIQ Architecten (NL)., FORMAT D2 (FRA), Ines Camacho (BE), Hans van der Heijden (NL), Hauschil-Siegel (SE/DEN), Henley Halebrown (UK), Jakob + MacFarlane (FR), Karakusevic Carson Architects (UK), Lacaton et Vassal Architectes (FR), LAN Architecture (FR), Mikhail Riches (UK), Rolf Disch (DE), S333 Architecture (UK), Sean Harrington Architects (IE)
Rest of World	BNIM (US), HDR (US), Kohn Pederson Fox (US), The Miller Hull Partnership (US), PTW Architects (AUS), Touloukian Touloukian (US), WOHA (Singapore), WRNS Studio (US)

Construction Finance & Crowdfunding Companies:

- Provide capital to construction companies for financing the realisation of specific projects.
- May be specialised in sustainable development and social housing finance.
- May also take the form of alternative sources of capital such as crowdfunding platforms, which match capital supply (investors) with capital demand (building owners or developers) in exchange for a fee.

Table 9 Illustrative Target Companies for RINNO Exploitation (Construction Finance & Crowdfunding Companies)

Region	Sub-segment	Indicative Companies
Europe	Traditional providers	Bank of Ireland (EI), HSBC (UK), BNP Paribas (FR), Crédit Agricole (FR), Banco Santander (ES), Lotus Investment Group (IE), Cullaun Capital (IE), Bibby Financial Services Ltd (UK), DLL Financial Solutions Partner (NL).
	Crowdfunding and other alternative platforms	Crowdproperty (UK), CrowdLonrds (UK), Walliance (IT), Urbanitae (ES), PropCrowd (ES), FundingOptions (UK), Crowd Real Estate (NL).
Rest of the World	Traditional providers	JPMorgan Chase & Co. (US), Citigroup (US), China Construction Bank (CN).
	Crowdfunding and other alternative platforms	BuildingBits (US), Fundrise (US), NexusCrowd (CA), R2 Investments (CA), M2Crowd (MX), Brickx (AU), Urbe.me (BR)

Residential Building Owners:

- Own and manage residential buildings.
- Wish to renovate their building stock cost efficiently while at the same time minimizing disturbance to occupants and overall renovation time.
- Aim to increase energy efficiency and environmental performance to meet or exceed national standards, meet domestic or European policy goals, maximise occupant satisfaction, and ultimately increase the value of the property.
- May require external capital to finance a renovation project, traditionally from banks in the form of medium to long term loans.

Table 10 Illustrative Target Companies for RINNO Exploitation (Residential Building Owners)

Region	Indicative Companies
Europe	ATC Piemonte Centrale (Italy), CASA SPA (Italy), Deutsche Wohnen (DE), Habitat 76 (France), Heimstaden (SE), LudvikaHem AB (Sweden), GECINA (FRA), Paris Habitat (FR), SAGA (DE), Sanctuary Housing (UK), SLRB Brussels (BE), SNI Group (FR), Stadt Wien (AT), Svenska Bostader (SE), VESTIA (NL), Vilogia (FRA), Visesa (ES), Vonovia (DE), Wheatley Group (UK)
Rest of World	NCORE (US), Omni New York, LLC (US), Sidewalk Labs (US), Toronto Community Housing (CAN), Urban Renaissance Agency (JAP), US Department of Housing & Urban Development (HUD)(US)

4.2 Energy Solutions & Construction Technology Providers, and ISVs - Positioning

What Customer Needs Do We Address?

For ES&CT providers and ISVs who want to improve, extend, or complement their existing product/service offering, RINNO represents a cost-effective way to add value to their existing product and service offering and/or solutions catalogue, differentiate themselves from competitors, and generate incremental revenues with comparatively little upfront R&D investment.

Key Messages

- Access to state-of-the-art standards-based technologies from key domain experts.
- Accelerate time-to-market and increase agility by leveraging a €4.5 million R&D investment validated in the field.
- Increase competitiveness through new value-added products and services.

Elevator Pitch

RINNO provides access to millions of euros of validated R&D for adding value to existing energy solutions, construction technologies, and software, and generating revenue from the deep renovation market.

Net Impression

“RINNO will improve our competitiveness and generate revenues from the deep renovation market.”

4.3 Residential Development and Construction Companies – Positioning

What Customer Needs Do We Address?

For residential development and construction companies who want to generate incremental and more profitable revenues from the deep renovation market, and provide a state-of-the-art technology-based solution, RINNO will provide a high-impact best-value solution. Residential development and construction companies can leverage RINNO's expert technical team and solutions to reduce the inconvenience to occupants, the time and the cost required for deep energy renovation of residential buildings, while dramatically improving energy performance, and customer and occupant satisfaction.

Key Messages

- Leverage a €4.5 million investment in validated R&D investment to generate incremental more profitable revenues.
- Reduce time and effort to deliver higher energy performance to building owners.
- Increase competitiveness and differentiation in the residential deep renovation market through superior services and improved profitability.

Elevator Pitch

RINNO delivers greater building energy performance at a lower cost for deep renovation projects by developing a novel suite of processes and technologies.

Net Impression

"RINNO will develop a novel suite of solutions for generating incremental revenues and increased profitability from deep renovation projects in the European residential building market, while improving energy performance."

4.4 Sustainable Architects – Positioning

What Customer Needs Do We Address?

RINNO will automate and accelerate the collection of data from multiple sources for pre-, in-, and post project evaluation for optimisation, remediation and future learning. For architects who want to supervise and/or monitor the entire renovation life cycle in a collaborative environment developed specifically for sustainable deep renovation, RINNO will provide an enabling workflow and state-of-the art suite of software tools. For architects who wish to simulate the interdependencies between multiple aspects of the renovation process and model different renovation scenarios, RINNO will provide state-of-the-art decision-making tools for optimal renovation configuration and remediation. RINNO will accelerate and improve decision-making, design configuration assessment, and reduce risk associated

with sub-optimal designs. As a result, RINNO will help architects deliver maximal energy performance faster and at lower costs.

Key Messages

- Leverage a €4.5 million investment in validated R&D investment to deliver superior designs with maximal energy performance faster and lower cost.
- Reduce time and effort to collect data, model designs and simulate performance of designs in different renovation scenarios.
- Improve organisational learning through social collaboration and AR training.
- Increase competitiveness and differentiation in the residential deep renovation market through superior services and improved profitability.

Elevator Pitch

RINNO reduces the risk of sub-optimal renovation designs through improved data collection, modelling, simulation and scenario analysis, and full lifecycle monitoring and management. RINNO delivers renovation designs with maximal energy performance faster and at a lower cost for deep renovation projects using a state-of-the-art suite of processes and technologies.

Net Impression

“RINNO allows architects design and manage deep renovation projects that will deliver maximal energy performance through advanced intelligence, analysis, modelling and management systems.”

4.5 Construction Finance and Crowdfunding Platforms – Positioning

What Customer Needs Do We Address?

Capital availability is critical for both construction companies and building owners in order to exploit market opportunities and cost reduction related to more efficient energy usage, and to reduce the environmental footprint of existing building stock. Traditional sources of capital cannot fulfil the demand and are constrained by regulation. RINNO aims to leverage crowdfunding to increase capital availability for renovation projects for both building owners and construction companies. Different from existing crowdfunding platforms for real estate investments, RINNO’s crowdfunding platform is based on smart contracts built on top of a blockchain therefore ensuring full transparency and accountability for all stakeholders.

Key Messages

- Access to state-of-art blockchain-based technologies for crowdfunding and energy performance contracting.
- Reduce risk through smart contract enforcement.
- Accelerate time to market and increase agility by leveraging a €4.5 million investment in

validated R&D investment.

- Increase competitiveness through new value-added functionalities and alternative financing mechanisms.

Elevator Pitch

RINNO provides access to millions of euros of validated R&D for integrating smart contract technologies into crowdfunding and collaborative financing platforms, thus adding value to existing funding platforms and generating greater revenue from the deep renovation market, while reducing investment search costs and ensuring greater transparency and accountability for investors.

Net Impression

“RINNO will improve our competitiveness and generate revenues from the deep renovation market while providing investors with reduced investment search costs, greater transparency and accountability through smart contracts.”

4.6 Residential Building Owners – Positioning

What Customer Needs Do We Address?

For building owners who want to increase the energy efficiency of their buildings, improve occupant satisfaction, and increase the value of their property, RINNO will provide a high-impact best-value solution. RINNO will reduce the time to completion of deep renovation projects and reduce inconvenience to occupants, while dramatically improving energy performance, and occupant satisfaction. Taken together, these have an induced effect of increasing property values.

Key Messages

- Increased occupant satisfaction and improved energy efficiency will increase property values.
- RINNO is a best-value state-of-the-art solution for delivering building energy performance.
- Deep renovation using RINNO is less intrusive, faster, and has a greater impact than existing approaches.

Elevator Pitch

RINNO can increase property value by delivering greater building energy performance, faster and at a lower cost for deep renovation projects with lower occupant disturbance than existing approaches.

Net Impression

“RINNO will develop a novel solution for dramatically improving energy performance in residential buildings faster and less intrusively than existing approaches.”

4.7 Features, Advantages, & Benefits of RINNO

Table 11 presents the features, advantages, and benefits of RINNO, mapped against the user stories presented in RINNO project documentation.

Table 11 RINNO Features, Advantages, & Benefits

Feature	Advantage	Benefit	Associated Deliverables
Innovative, hybrid and efficient integrated solutions through an adaptive comprehensive repository of technologies.	Plug-n-play modular elements are easier to install and combine than traditional solutions and can be integrated with other existing systems.	• Quicker installation times result in lower installation costs and less disturbance for occupants. • Modular elements can be integrated with existing systems and represent a viable solution for existing building and small-scale projects.	D2.1 D2.2
	Bio-based modular elements provide high thermal efficiency and isolation.	• Easier to recycle therefore reducing their environmental impact. • Thermal and acoustic insulation improve the overall energy efficiency of the building and comfort for occupants.	D2.1 D2.2
	Renewable energy harvesting and storage solutions can be integrated within structural building elements.	• Generate energy from renewable resources and store it on-site therefore reducing the environmental footprint of a building. • Reduced energy costs for the occupant. • Increased flexibility in terms of design and improved aesthetics of the building.	D2.3 D2.6 D2.7
Fast and occupant-centred renovation planning and design.	Automated mapping of the building and renovation design.	• Fast development of an accurate digital representation of the building. • Simplified design process and reduced disturbance for the occupants.	D3.1 D3.2 D3.3 D3.4

	Ex-ante selection of the optimal renovation scenario based on a holistic approach to energy, environmental, and techno-economic aspects as well as user preferences and site restrictions.	• Accurate simulation of building elements and energy systems interoperability. • Estimate of the future operational performance of the building. • Reduced uncertainty for different stakeholders regarding the expected outcomes of the renovation.	D3.5 D3.6
	Automated renovation plan generation and optimisation.	• Automatically generated and fully optimized renovation plan that considers the entire renovation lifecycle. • Minimize renovation time, cost, waste production, occupants' disruption time and level and assembly/disassembly easiness.	D3.7 D3.8
Innovative construction and process optimization methods, and real-time monitoring tools for quality control.	Real time data gathering allows to closely monitor the entire renovation process. Inefficiencies are identified and removed quickly ensuring on-time delivery.	• Reduced renovation time, cost and disruption for the occupants. • Reducing the energy-requirements and environmental impact of the renovation process.	D4.3 D4.4 D4.5 D4.6 D4.9
	The combination of on-site and off-site automated or semi-automated assembling of prefabricated components accelerates the overall renovation process and reduces manual work on-site.	• Reduced renovation time. • Increases the health and safety of the renovation site. • Reduces body stress for workers.	D4.1 D4.2
	"On-the-job" training and remote assistance reduce inefficiencies and avoids delay in the overall renovation process.	• Use of AR/VR tools for real-time training and assistance ensures that workers develop adequate knowledge of different building elements and energy systems. • Reduced renovation time and better-quality results.	D4.7 D4.8

		• Increased health and safety of the renovation site and improved working condition of on-site workers.	
Context-aware operational platform with augmented intelligence for real-time building performance awareness and performance gap quantification.	Performance measurement of the building based on KPIs identified at the design stage and real-time monitoring through easy-to-understand management dashboards.	• Greater control over the energy performance of the building. • Visibility of pre- v. post-renovation performance gap and on the overall outcomes of the renovation.	D5.2 D5.3 D5.4 D5.7
	Information and knowledge sharing between different stakeholders throughout the renovation lifecycle.	• Increased transparency and efficiency throughout the renovation lifecycle.	D5.5 D5.6
Circular economy-driven business models (BMs) and financing schemes.	The design of incentive schemes based on circular economy principles ensures sustained post-renovation behavioural change of building users.	• Reduced environmental footprint of the overall renovation lifecycle. • Reduced energy costs for the occupants.	D7.1 D7.2 D7.3 D7.4 D7.5
	Purposefully designed smart contracts based on energy performance, and “Product as a Service” (PaaS) models reduce the risk of energy efficiency investments on buildings renovation	• Increased attractiveness of building renovation investments for both private and institutional investors. • Increased capital availability and renovation rate.	D7.6 D7.7 D7.8

5. Preliminary Analysis of Commercialisation Factors

5.1 Approach

A preliminary analysis of the commercialisation factors has been conducted using four primary parameters adapted from Penin (2010) – the nature of the innovation, technological regime, competition regime and target licensees. Table 12 summarises the considerations for each of these parameters.

Table 12 Summary of Anticipated IP Contributions Adapted from Penin (2010)

Nature of Innovation	Distance to the Market	Embryonic
		Mature
	Specificity	Generic
		Specific
Technological Regime	Appropriability	High (Weak)
		Low (Strong)
	Complexity	Discrete (Simple)
		Complex
	Dependency	High
		Low
	Speed of Technical Progress	Slow
		Rapid
Competition Regime	Size of Market	Large
		Small
	Intensity of Competition	High
		Low
Type of Licensee/Buyer	Firm Size	Large
		Small
	Firm Life Stage	Start-up
		Mature
Exploitation Intention	Intend to Apply for Patent	Yes
		No
	Exploitation Intention	Solely
		With other RINNO partner(s)
		Via a Joint Venture with all RINNO partners

As per Ozel and Penin (2016), the nature of IP contributions is considered along two primary dimensions. The first dimension, Distance to the Market, indicates whether an IP contribution is Embryonic (far from market) or Mature (close to the market). Embryonic implies further investment in development is required before income can be generated from the IP; Mature implies the IP is immediately usable by firms without further investment. Extant research, although somewhat dated, suggests that most university research outputs can be classified as Embryonic and are either proof-of-concepts or lab-scale prototypes resulting in commercialisation through exclusive licensing (Jensen and Thursby, 2001). For the purposes of this report, we use self-reported technology readiness levels (TRLs) as defined by Annex G of the Horizon 2020 Work Programme General Annexes. Table 13

presents the definitions applied. Research suggests that if a technology is too embryonic, the likelihood of transfer is low whereas if moderately embryonic, exclusive or semi-exclusive licensing is possible. However, there are inefficiency risks if global exclusivity is granted (Ozel and Penin, 2016). If Mature, non-exclusive commercialisation is optimal; non-commercialisation or global exclusivity introduces inefficiency risks. The second dimension, Specificity, seeks to categorize IP as Generic (or general purpose) in that it can be used in many different applications or many sectors. In contrast, Specific suggests the IP can only be used for one particular application or one particular sector.

Table 13 Distance to the Market as Defined by Technology Readiness Level

Distance to the Market	TRL	Definition
Embryonic (Far from Market)	1	Basic principles observed
	2	Technology concept formulated
	3	Experimental Proof-of-Concept
	4	Technology validated in lab
	5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
	6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
	7	Technology or system prototype demonstration in operational environment
Mature (Close to the Market)	8	Technology or system complete and qualified
	9	Actual technology or system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

The technological regime refers to the combination of particular factors specific to a technology as it pertains to a sector and affects the strategy of actors operating there (Nelson and Winter, 1982). Penin (2010) identified three dimensions - the degree of appropriability, the complex or discrete nature of technology, and speed of technical progress, which determines the importance of technological opportunities. Appropriability relates to the degree to which competitors can appropriate the technology and is impacted by a variety of factors including the presence of patents, the existence of complementary protected assets and high replication costs. The easier it is to appropriate a technology, the more likely an exclusive license is required. Kingston (2001) suggests that the Complex or Discrete nature of technology is an important determinant of commercialisation. Here Discrete technologies have less dependencies on third party technologies whereas Complex technologies often rely on third party components to function or bring to market. As such, exclusivity may be complicated for Complex innovations resulting in slower than expected go-to-market times. Speed of Technical Progress refers to the pace and dynamism of innovation within a domain or sector. Where there is a fast pace of technical progress and greater opportunities, exclusivity can obstruct competitors and similarly there is enough demand that licenses may not require exclusivity as they are motivated by early mover advantages.

The competition framework refers to the market size and elasticity of demand (Size of Market) and the number of companies and intensity of rivalry between them (Intensity of Competition) (Penin, 2010). If the Size of Market is small, then exclusivity is more likely to be required and is impacted by Distance to the Market. Similarly, industry structure is characterized by low competitive rivalry or even a monopoly, then exclusivity is less important as licensees can use their industry position as leverage.

5.2 Key Exploitable Results

Table 14 summarises the key project results that are exploitable by partners on completion of the project. In the initial assessment some differences in exploitation intention and preferences have emerged that will need to be resolved as the project progresses. These relate to subsidiary innovations and contributions to elements of the RINNO Suite, namely the RINNO Planning & Design Assistant (CIRCE, CERTH, RINA, UNN), the RINNO Retrofit Manager (BYCN, Motivian), and the RINNO Building Lifecycle Renovation Manager (CERTH, Motivian) (see Table 14). Currently, six partners, EKOLAB, PINK, BYCN, CERTH, MOTIVIAN and K-FLEX envisage applying for patents for foreground IP (see Table 19).

Table 14 Summary of Key Exploitable Results

Item No.	Key Exploitable Results	Partner(s)	Anticipated TRL at M48	Anticipated License	Contribution	Resolution Action Required
1	**Plug-n-Play Modular Building Envelope Elements**					
1.1	Bio-based double layer panels	K-FLEX	9	Proprietary	RINNO-Specific	No
1.2	Bio-based pipes and sheets	K-FLEX	9	Proprietary	RINNO-Specific	No
1.3	Isocell Cellulose Insulation	EKOLAB	9	Proprietary	General	No
1.4	Thermochromic Glass	GREENSTRUCT	9	Proprietary	General	No
2	**RES Harvesting and Hybrid Solutions**					
2.1	K-BOX bio-based insulating system for parts of energy systems	K-FLEX	9	Proprietary	RINNO-Specific	No
2.2	Climate Cover PV -Roof and -Facade solutions	EKOLAB	9	Proprietary	General	No
2.3	MicroVent sustainable Ventilation system	EKOLAB	9	Proprietary	General	No
2.4	Building Integrated Photovoltaic Glass	GREENSTRUCT	9	Open source	RINNO-Specific	No
3	**De-centralized domestic hot water preparation**					
3.1	Wall integrated storage tank	Pink	9	Proprietary	General	No
3.2	Wall mounted storage tank	Pink	9	Proprietary	General	No
3.3	Electrical charging system	Pink	9	Open source	General	No
3.4	Electrical control system	Pink	9	Proprietary	General	No
3.5	Hydraulic charging system	Pink	9	Open source	General	No
3.6	Hydraulic control system	Pink	9	Open source	General	No
3.7	Prefabricated hydraulic module	Pink	9	Open source	General	No
3.8	Biobased Insulation	Pink	7	Open source	General	No

4	**RINNO Planning & Design Assistant**					
4.1	Immersive Building Capturing & Mapping	BYCN	7	Proprietary	General	No
4.2	Digital Twin toolkit	VTT	6	Proprietary	RINNO-Specific	No
4.3	Renovation Simulation & Assessment Toolbox, which includes:					
4.3.1	Energy Assessment Toolkit (INTEMA)	CERTH	8	Proprietary	General	No
4.3.2	Environmental, Cost and Social Assessment Toolkit	CIRCE/CERTH	8/9	Proprietary	General	Yes
4.3.3	Techno-economical Assessment Toolkit	RINA/UNN	8/9	Open source	RINNO-Specific	Yes
4.3.4	Renovation Optimizer & Planner	CERTH	8	Proprietary	General	No
5	**RINNO Retrofit Manager**					
5.1	Recommendation Engine for Industrialized Retrofitting	BYCN	7	Proprietary	General	No
5.2	Logistics & Process Optimization Tool	BYCN/MOTIVIAN	7	Proprietary, Open source	General	Yes
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	BYCN	7	Proprietary	General	No
5.4	On-the-job AR facilitating environment	CERTH	7	Proprietary	General	No
5.5	Retrofitting Process Manager	MOTIVIAN/UNN	8/9	Proprietary	RINNO-Specific	Yes
6	**RINNO Building Lifecycle Renovation Manager**					
6.1	Multi-Purpose IoT-Enabled Building Monitoring	CERTH/ MOTIVIAN	8/9	Proprietary	General	Yes
6.2	Renovation Validation and Benchmarking Tool	CERTH	8	Proprietary	General	No
6.3	Renovation Marketplace and Social Collaboration Platform	CERTH	8	Proprietary	General	No
6.4	Building Renovation Passports and Logbook	CIRCE	3	Proprietary	RINNO-Specific	No

7	**Renovation Workflow and Transaction Manager**	MOTIVIAN	9	Proprietary	General	No
8	**Business Models**					
8.1	Deep renovation Business Models Guidelines	REGENERA	9	Proprietary	General	No
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	REGENERA	9	Proprietary	General	No

5.3 Nature of Innovation

Table 15 provides an overview of the current anticipated status of RINNO IP contributions as reported by the consortium partners in the initial assessment. As can be seen, of the 35 IP contributions, 28 are expected to achieve TRL 8 or 9 by M48; and 33 at TRL of 7-9. Only the Digital Twin Toolkit (TRL 6) and the Building Renovation Passports and Logbook (TRL 3) will achieve lower levels of technology readiness. It should be noted that while the markets for many of the products are at high states of readiness, the RINNO Suite is a relatively novel proposal and accordingly the market has been rated as embryonic as a whole.

Table 15 Preliminary Analysis of Nature of Innovation for Anticipated RINNO IP Contributions

Item No.	Key Exploitable Results	Distance to Market	Specificity	Resolution Action Required
1	**Plug-n-Play Modular Building Envelope Elements**			
1.1	Bio-based double layer panels	Mature	Generic	No
1.2	Bio-based pipes and sheets	Mature	Generic	No
1.3	Isocell Cellulose Insulation	Mature	Generic	No
1.4	Thermochromic Glass	Mature	Generic	No
2	**RES Harvesting and Hybrid Solutions**			
2.1	K-BOX bio-based insulating system for parts of energy systems	Mature	Specific	No
2.2	Climate Cover PV -Roof and -Facade solutions	Mature	Generic	No
2.3	MicroVent sustainable Ventilation system	Mature	Generic	No
2.4	Building Integrated Photovoltaic Glass	Mature	Generic	No
3	**De-centralized domestic hot water preparation**			
3.1	Wall integrated storage tank	Mature	Specific	No
3.2	Wall mounted storage tank	Mature	Specific	No
3.3	Electrical charging system	Mature	Specific	No
3.4	Electrical control system	Mature	Specific	No
3.5	Hydraulic charging system	Mature	Specific	No
3.6	Hydraulic control system	Mature	Specific	No
3.7	Prefabricated hydraulic module	Mature	Specific	No
3.8	Biobased Insulation	Mature	Specific	No
4	**RINNO Planning & Design Assistant**			
4.1	Immersive Building Capturing & Mapping	Mature	Specific	No
4.2	Digital Twin toolkit	Embryonic	Specific	No
4.3	Renovation Simulation & Assessment Toolbox, which includes:			
4.3.1	Energy Assessment Toolkit (INTEMA)	Mature	Specific	No
4.3.2	Environmental, Cost and Social Assessment Toolkit	Mature	Specific	No
4.3.3	Techno-economical Assessment Toolkit	Mature/	Generic/	Yes

		Embryonic	Specific	
4.3.4	Renovation Optimizer & Planner	Embryonic	Generic	No
5	**RINNO Retrofit Manager**			
5.1	Recommendation Engine for Industrialized Retrofitting	Embryonic	Specific	No
5.2	Logistics & Process Optimization Tool	Mature/ Embryonic	Specific	Yes
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	Embryonic	Specific	No
5.4	On-the-job AR facilitating environment	Embryonic	Specific	No
5.5	Retrofitting Process Manager	Embryonic	Generic/ Specific	Yes
6	**RINNO Building Lifecycle Renovation Manager**			
6.1	Multi-Purpose IoT-Enabled Building Monitoring	Mature	Generic/ Specific	Yes
6.2	Renovation Validation and Benchmarking Tool	Mature	Specific	No
6.3	Renovation Marketplace and Social Collaboration Platform	Embryonic	Generic	No
6.4	Building Renovation Passports and Logbook	Embryonic	Generic	No
7	**Renovation Workflow and Transaction Manager**	Embryonic	Generic	No
8	**Business Models**			
8.1	Deep renovation Business Models Guidelines	Embryonic	Generic	No
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	Embryonic	Generic	No

5.4 Technological Regime

Table 16 provides a summary of a preliminary assessment of the technological regime for RINNO IP contributions. As can be seen from Table 16, the perceived appropriability of RINNO technologies varies. Products that rely on proprietary technologies or manufacturing processes are more difficult for industry to appropriate while some of the RINNO software architecture, which may be based on open source software is easier to consume, and indeed has been designed to do so. Similarly, complex innovations often rely on third party components to function and bring to market. As such, exclusivity may be complicated resulting in slower than expected go-to-market times. While the overall RINNO Suite (system) can be considered *Discrete*, subsidiary components make use of a wide variety of third-party software or components, and adoption will depend on continuing inclusion, integration and interfaces with third party data and systems. Finally, the preliminary analysis suggests that the speed of technical progress varies across the IP contributions. Where there is more dynamism and fast pace of technical progress, exclusivity can obstruct competitors however may not be needed given demand in the market and early mover advantage. Clearly, the more physical RINNO IP contributions are characterised by slower technical progress while software elements may progress at a faster pace. In

future iterations of this report, additional analysis of dependencies may support alternative options and commercialisation pathways.

Overall, preliminary analysis suggests the partners perceive the overall market space as relatively complex and it may not be feasible to pursue a fully joint exploitation strategy.

Table 16 Preliminary Analysis of Technological Regime for Anticipated RINNO IP Contributions

Item No.	Key Exploitable Results	Appropriability	Complexity	Dependency	Speed of Technical Progress	Resolution Action Required
1	**Plug-n-Play Modular Building Envelope Elements**					
1.1	Bio-based double layer panels	Low (Strong)	Complex	Low	Slow	No
1.2	Bio-based pipes and sheets	Low (Strong)	Complex	Low	Slow	No
1.3	Isocell Cellulose Insulation	High (Weak)	Complex	High	Slow	No
1.4	Thermochromic Glass	Low (Strong)	Discrete (Simple)	High	Rapid	No
2	**RES Harvesting and Hybrid Solutions**					
2.1	K-BOX bio-based insulating system for parts of energy systems	Low (Strong)	Complex	Low	Slow	No
2.2	Climate Cover PV - Roof and -Facade solutions	Low (Strong)	Complex	Low	Rapid	No
2.3	MicroVent sustainable Ventilation system	Low (Strong)	Complex	High	Rapid	No
2.4	Building Integrated Photovoltaic Glass	High (Weak)	Complex	High	Rapid	No
3	**De-centralized domestic hot water preparation**					
3.1	Wall integrated storage tank	Low (Strong)	Complex	Low	Slow	No
3.2	Wall mounted storage tank	Low (Strong)	Complex	Low	Slow	No
3.3	Electrical charging system	High (Weak)	Discrete (Simple)	High	Slow	No
3.4	Electrical control system	Low (Strong)	Complex	High	Slow	No
3.5	Hydraulic charging system	Low (Strong)	Discrete (Simple)	Low	Rapid	No
3.6	Hydraulic control system	High (Weak)	Discrete (Simple)	Low	Slow	No

3.7	Prefabricated hydraulic module	Low (Strong)	Complex	Low	Rapid	No
3.8	Biobased Insulation	High (Weak)	Discrete (Simple)	Low	Slow	No
4	**RINNO Planning & Design Assistant**					
4.1	Immersive Building Capturing & Mapping	High (Weak)	Discrete (Simple)	High	Rapid	No
4.2	Digital Twin toolkit	Low (Strong)	Discrete (Simple)	Low	Rapid	No
4.3	Renovation Simulation & Assessment Toolbox, which includes:					
4.3.1	Energy Assessment Toolkit (INTEMA)	High (Weak)	Complex	High	Rapid	No
4.3.2	Environmental, Cost and Social Assessment Toolkit	High (Weak)/ Low (Strong)	Complex/ Discrete (Simple)	Low/High	Slow/ Rapid	Yes
4.3.3	Techno-economical Assessment Toolkit	High (Weak)/ Low (Strong)	Complex/ Discrete (Simple)	High	Rapid	Yes
4.3.4	Renovation Optimizer & Planner	High (Weak)	Discrete (Simple)	Low	Slow	No
5	**RINNO Retrofit Manager**					
5.1	Recommendation Engine for Industrialized Retrofitting	High (Weak)	Discrete (Simple)	High	Rapid	No
5.2	Logistics & Process Optimization Tool	Low (Strong)	Complex	Low/High	Slow/ Rapid	Yes
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	Low (Strong)	Complex	Low	Slow	No
5.4	On-the-job AR facilitating environment	High (Weak)	Discrete (Simple)	Low	Rapid	No
5.5	Retrofitting Process Manager	High (Weak)/ Low (Strong)	Complex	Low/High	Slow	Yes
6	**RINNO Building Lifecycle Renovation Manager**					
6.1	Multi-Purpose IoT-Enabled Building Monitoring	High (Weak)/ Low (Strong)	Discrete (Simple)	Low/High	Rapid	Yes
6.2	Renovation Validation and Benchmarking Tool	High (Weak)	Discrete (Simple)	Low	Rapid	No
6.3	Renovation Marketplace and	High (Weak)	Complex	High	Rapid	No

	Social Collaboration Platform					
6.4	Building Renovation Passports and Logbook	High (Weak)	Discrete (Simple)	Low	Rapid	No
7	**Renovation Workflow and Transaction Manager**	Low (Strong)	Discrete (Simple)	High	Rapid	No
8	**Business Models**					
8.1	Deep renovation Business Models Guidelines	High (Weak)	Complex	High	Slow	No
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	High (Weak)	Complex	High	Slow	No

5.5 Competition Regime

As can be clearly seen from Section 4, RINNO has the potential to be marketed to multiple markets. Table 17 presents the results of the preliminary assessment of the relative size of the market and intensity of competition for each RINNO IP contribution. This preliminary analysis suggests that RINNO partners are relatively optimistic about the market opportunity however note that in each space, there are indicators of intense competition for specific features. Over the remainder of the project, additional market assessment and competitor analysis is required to support these perceptions and inform strategic options.

Table 17 Preliminary Analysis of Competition Regime for Anticipated RINNO IP Contributions

Item No.	Key Exploitable Results	Size of the Market	Intensity of Competition	Resolution Action Required
1	**Plug-n-Play Modular Building Envelope Elements**			
1.1	Bio-based double layer panels	Large	High	No
1.2	Bio-based pipes and sheets	Large	High	No
1.3	Isocell Cellulose Insulation	Large	High	No
1.4	Thermochromic Glass	Small	Low	No
2	**RES Harvesting and Hybrid Solutions**			
2.1	K-BOX bio-based insulating system for parts of energy systems	Large	High	No
2.2	Climate Cover PV -Roof and -Facade solutions	Large	Low	No
2.3	MicroVent sustainable Ventilation system	Large	Low	No
2.4	Building Integrated Photovoltaic Glass	Large	High	No
3	**De-centralized domestic hot water preparation**			
3.1	Wall integrated storage tank	Large	High	No
3.2	Wall mounted storage tank	Small	Low	No
3.3	Electrical charging system	Large	High	No
3.4	Electrical control system	Large	High	No
3.5	Hydraulic charging system	Large	Low	No
3.6	Hydraulic control system	Large	High	No
3.7	Prefabricated hydraulic module	Small	Low	No
3.8	Biobased Insulation	Small	Low	No
4	**RINNO Planning & Design Assistant**			
4.1	Immersive Building Capturing & Mapping	Large	High	No
4.2	Digital Twin toolkit	Large	High	No
4.3	Renovation Simulation & Assessment Toolbox, which includes:			
4.3.1	Energy Assessment Toolkit (INTEMA)	Large	High	No
4.3.2	Environmental, Cost and Social Assessment Toolkit	Large	Low/High	Yes
4.3.3	Techno-economical Assessment Toolkit	Small, Large	Low/High	Yes
4.3.4	Renovation Optimizer & Planner	Large	Low	No
5	**RINNO Retrofit Manager**			
5.1	Recommendation Engine for Industrialized Retrofitting	Large	Low	No
5.2	Logistics & Process Optimization Tool	Large	Low/High	Yes
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	Large	High	No
5.4	On-the-job AR facilitating environment	Large	Low	No
5.5	Retrofitting Process Manager	Large	Low	No
6	**RINNO Building Lifecycle Renovation Manager**			
6.1	Multi-Purpose IoT-Enabled Building Monitoring	Large	Low/High	Yes

6.2	Renovation Validation and Benchmarking Tool	Small	Low	No
6.3	Renovation Marketplace and Social Collaboration Platform	Large	Low	No
6.4	Building Renovation Passports and Logbook	Large	High	No
7	**Renovation Workflow and Transaction Manager**	Large	Low	No
8	**Business Models**			
8.1	Deep renovation Business Models Guidelines	Large	High	No
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	Large	High	No

5.6 Type of Licensee/Buyer

Table 18 presents a summary of the preliminary assessment of the type of licensee/buyer for each RINNO IP contribution. This preliminary analysis reflects the structure and maturity of the construction industry as a whole and the nature of the innovations. The software ratings reflect that such innovations are likely to be exploited by a start-up/spin-out and indeed reflect the exploitation intentions of the partner as detailed in Section 5.7 (Table 19).

Table 18 Preliminary Analysis of Licensees/Buyers for Anticipated RINNO IP Contributions

Item No.	Key Exploitable Results	Firm Size	Firm Life Stage	Resolution Action Required
1	**Plug-n-Play Modular Building Envelope Elements**			
1.1	Bio-based double layer panels	Large	Mature	No
1.2	Bio-based pipes and sheets	Large	Mature	No
1.3	Isocell Cellulose Insulation	Large	Mature	No
1.4	Thermochromic Glass	Small	Mature	No
2	**RES Harvesting and Hybrid Solutions**			
2.1	K-BOX bio-based insulating system for parts of energy systems	Large	Mature	No
2.2	Climate Cover PV -Roof and -Facade solutions	Large	Mature	No
2.3	MicroVent sustainable Ventilation system	Large	Mature	No
2.4	Building Integrated Photovoltaic Glass	Small	Mature	No
3	**De-centralized domestic hot water preparation**			
3.1	Wall integrated storage tank	Small	Mature	No
3.2	Wall mounted storage tank	Small	Mature	No
3.3	Electrical charging system	Large	Mature	No
3.4	Electrical control system	Large	Mature	No
3.5	Hydraulic charging system	Large	Mature	No
3.6	Hydraulic control system	Small	Mature	No
3.7	Prefabricated hydraulic module	Small	Mature	No
3.8	Biobased Insulation	Small	Mature	No
4	**RINNO Planning & Design Assistant**			

4.1	Immersive Building Capturing & Mapping	Large	Mature	No
4.2	Digital Twin toolkit	Small	Start-up	No
4.3	Renovation Simulation & Assessment Toolbox, which includes:			
4.3.1	Energy Assessment Toolkit (INTEMA)	Small	Start-up	No
4.3.2	Environmental, Cost and Social Assessment Toolkit	Small/ Large	Mature/ Start-up	Yes
4.3.3	Techno-economical Assessment Toolkit	Large	Mature	No
4.3.4	Renovation Optimizer & Planner	Small	Start-up	No
5	**RINNO Retrofit Manager**			
5.1	Recommendation Engine for Industrialized Retrofitting	Large	Mature	No
5.2	Logistics & Process Optimization Tool	Large	Mature	No
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	Large	Mature	No
5.4	On-the-job AR facilitating environment	Large	Start-up	No
5.5	Retrofitting Process Manager	Small/ Large	Mature	Yes
6	**RINNO Building Lifecycle Renovation Manager**			
6.1	Multi-Purpose IoT-Enabled Building Monitoring	Small	Mature/ Start-up	Yes
6.2	Renovation Validation and Benchmarking Tool	Small	Start-up	No
6.3	Renovation Marketplace and Social Collaboration Platform	Small	Start-up	No
6.4	Building Renovation Passports and Logbook	Large	Mature	No
7	**Renovation Workflow and Transaction Manager**	Large	Mature	No
8	**Business Models**			
8.1	Deep renovation Business Models Guidelines	Small	Mature	No
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	Small	Mature	No

5.7 Preliminary Exploitation intention

Table 19 presents the preliminary exploitation intentions for each RINNO IP contribution as declared by consortium partners at M24. This analysis suggests that at this point in time the partners wish to pursue individual or bilateral exploitation plans and not a consortium-wide exploitation vehicle. This is not whole unsurprising given the mix of physical and digital products and services and partner types.

Table 19 Preliminary Analysis of Exploitation Intentions of the RINNO Partners

Item No.	Key Exploitable Results	Partner(s)	Anticipated TRL at M48	Intend to Apply for Patent	Exploitation Intention	Resolution Action Required
1	**Plug-n-Play Modular Building Envelope Elements**					
1.1	Bio-based double layer panels	K-FLEX	9	No	With other RINNO partner(s)	No
1.2	Bio-based pipes and sheets	K-FLEX	9	No	With other RINNO partner(s)	No
1.3	Isocell Cellulose Insulation	EKOLAB	9	No	Solely	No
1.4	Thermochromic Glass	GREENSTRUCT	9	No	Solely	No
2	**RES Harvesting and Hybrid Solutions**					
2.1	K-BOX bio-based insulating system for parts of energy systems	K-FLEX	9	No	With other RINNO partner(s)	No
2.2	Climate Cover PV -Roof and -Facade solutions	EKOLAB	9	Yes	Solely	No
2.3	MicroVent sustainable Ventilation system	EKOLAB	9	Yes	Solely	No
2.4	Building Integrated Photovoltaic Glass	GREENSTRUCT	9	No	Solely	No
3	**De-centralized domestic hot water preparation**					
3.1	Wall integrated storage tank	Pink	9	Yes	Solely	No
3.2	Wall mounted storage tank	Pink	9	Yes	Solely	No
3.3	Electrical charging system	Pink	9	No	Solely	No
3.4	Electrical control system	Pink	9	Yes	Solely	No
3.5	Hydraulic charging system	Pink	9	No	Solely	No
3.6	Hydraulic control system	Pink	9	No	Solely	No
3.7	Prefabricated hydraulic module	Pink	9	No	Solely	No
3.8	Biobased Insulation	Pink	7	No	Solely	No
4	**RINNO Planning & Design Assistant**					

4.1	Immersive Building Capturing & Mapping	BYCN	7	No	With other RINNO partner(s)	No
4.2	Digital Twin toolkit	VTT	6	No	Solely	No
4.3	Renovation Simulation & Assessment Toolbox, which includes:					
4.3.1	Energy Assessment Toolkit (INTEMA)	CERTH	8	No	Solely	No
4.3.2	Environmental, Cost and Social Assessment Toolkit	CIRCE/CERTH	8, 9	No	Solely/With other RINNO partner(s)	Yes
4.3.3	Techno-economical Assessment Toolkit	RINA/UNN	8, 9	No	Solely/With other RINNO partner(s)	Yes
4.3.4	Renovation Optimizer & Planner	CERTH	8	No	Solely	No
5	**RINNO Retrofit Manager**					
5.1	Recommendation Engine for Industrialized Retrofitting	BYCN	7	No	Solely	No
5.2	Logistics & Process Optimization Tool	BYCN/ MOTIVIAN	7	Yes, No	Solely/With other RINNO partner(s)	Yes
5.3	COCKPIT Platform for Automated Progress, Quality and Security Control by Drones	BYCN	7	No	Solely	No
5.4	On-the-job AR facilitating environment	CERTH	7	No	Solely	No
5.5	Retrofitting Process Manager	MOTIVIAN/ UNN	8, 9	No	Solely/With other RINNO partner(s)	Yes
6	**RINNO Building Lifecycle Renovation Manager**					
6.1	Multi-Purpose IoT-Enabled Building Monitoring	CERTH/ MOTIVIAN	8, 9	No	Solely/With other RINNO partner(s)	rouri
6.2	Renovation Validation and Benchmarking Tool	CERTH	8	No	Solely	No
6.3	Renovation Marketplace and Social Collaboration Platform	CERTH	8	Yes	Solely	No

6.4	Building Renovation Passports and Logbook	CIRCE	3	No	Solely	No
7	**Renovation Workflow and Transaction Manager**	MOTIVIAN	9	Yes	With other RINNO partner(s)	No
8	**Business Models**					
8.1	Deep renovation Business Models Guidelines	REGENERA	9	No	With other RINNO partner(s)	No
8.2	Crowdfunding and post-renovation behavioural incentivisation options for investment financing	REGENERA	9	No	With other RINNO partner(s)	No

6. Academic Exploitation

The academic partners, led by DCU, will work together to develop and implement an academic exploitation plan so that technical developments are integrated into the teaching curricula and research agenda of partner institutions thereby providing their institutions and graduates a competitive edge over other higher education institutions. In addition to scholarly publications papers, this will include the production of the following:

Table 20 Academic Exploitation Support Materials

Learning Resources	Description
Lecture Script	A stock lecture script describing the building blocks and the main design principles behind different elements of the RINNO Suite.
PowerPoint Presentation and Walk Through	A PowerPoint presentation with walkthrough script on the RINNO Suite of its most innovative components.
Reading List and Support Resources	A reading list and other support resources.

As per the project's proposal, and as outlined in D8.1, each academic partner is tasked with organising at least one workshop over the lifetime of the project on taught or research programmes targeting a relevant student population. Evidence of inclusion in the formal syllabus, where appropriate and permissible is desirable.

7. Individual Exploitation Plans

Below is a summary of the preliminary individual exploitation plans, based on the project's proposal. These will be revisited and updated in deliverables D8.11 Exploitation Report and IPR Protection Plan V.2 and D8.12 Exploitation Report and IPR Protection Plan (Final) in M36 and M48 respectively.

7.1 RINA-C

RINA-C offers all services related to feasibility, design, and construction supervision for buildings. Innovative technological solutions, digital delivery, and advanced management tools are the key success factors in a fast-growing engineering sector. In this context, RINA-C's participation in the RINNO project will provide support for its sustainable renovation services offering. RINA-C will enlarge its solution portfolio and its engineering knowledge and offer not only sustainable construction and building certification services but also its own sustainable approaches to renovation.

RINA will benefit from its involvement in the development of the TEA (Techno-Economic assessment) tool as part of WP3. The TEA tool is part of the RINNO Planning & Design Assistant (RPDA), a decision support tool which will optimally match a wide spectrum of renovation needs. This will provide RINA-C with the opportunity to provide new and improved consultancy services exploiting the RINNO Suite as well opening new markets thanks to the experience acquired following deep renovation planning, authorisation and execution in different European contexts.

By participating in the RINNO project, RINA-C is expected to increase their revenue providing new engineering consultancy services in building and construction sector exploiting the growing BIM services market and digital solutions for the construction and renovation sector. Moreover, additional revenues are expected thanks to the creation of relevant commercial networks with project partners for mutual promotion and business development.

7.2 CERTH

CERTH will exploit the results of the RINNO project both directly and indirectly. A direct exploitation will be achieved by protecting the knowledge created by CERTH in the course of the project (foreground IP) through, for example, a patent or copyright, and granting licenses for its use. Indirect exploitation will be realised by increasing CERTH's leadership in the technology areas related to RINNO at a European level. CERTH expects that the technologies validated under RINNO will attract the interest of relevant enterprises and, as a result of that, initiate new collaborations with industrial partners for commercialisation.

RINNO provides an excellent opportunity for the development of market-ready solutions, for the demonstration of these tools in different buildings and countries, and for the dissemination of the results. As such, RINNO will allow CERTH to provide specific software solutions for the building renovation sector and enter a large market where a great number of large and small sized companies are operating.

CERTH has developed as part of RINNO, a series of software tools supporting buildings renovation process in relevant key market segments (energy analysis, LCA/LCC analysis) i.e. INTEMA.building and VERIFY. Addressing issues related to user-friendliness and usability, functionality and verification of results is particularly important to facilitate future commercialisation. CERTH has already conducted a workshop with Greek stakeholders interested in these tools to present them. Interested stakeholders have had access to the tools for a test period of approximately three weeks and have provided valuable feedback to the CERTH developing team. In addition to this, CERTH's developing team is interacting with IsZEB (https://iszeb.gr/), a Cluster Dedicated To "Intelligent Solutions For Zero & Positive Energy Buildings", to support the exploitation of the RINNO solutions in the Greek market.

CERTH also aims to exploit the RINNO Renovation Marketplace with Ricardian contracts which includes the renovation repository of the project along with third-party solutions. This can be exploited through royalties and/or partnerships with commercial stakeholders in Greece which are already established in the construction sector. Furthermore, the RINNO Social Platform with personalised IoT-Enabled building Monitoring and On-the-job AR training tool has been integrated into the building renovation lifecycle by CERTH's team for supporting flexible interaction between different stakeholders of the renovation process. CERTH will explore licensing opportunities for this IPR and associated revenue generation through royalties.

From a scientific perspective, CERTH plans to exploit the outcomes of the RINNO project in terms of scientific publications (at least four publications are expected) which would increase the critical mass of research produced by the organisation. To date, CERTH has already published two scientific publications (one peer-reviewed journal article and one conference paper) whilst another paper has been accepted in a conference. Additional publications are also included in the pipeline.

The increase in workload related to RINNO has required additional staff (research assistants and post-doctoral researchers) with very specific expertise leading to a further increase of the organisation's expertise in the field of construction and deep renovation.

7.3 REGENERA

REGENERA has experience in the energy efficiency sector having carried out several projects and innovation proposals in this space with a particular focus on Energy Service Companies (ESCOs) and

Energy Performance Contracting (EPC). The implementation, demonstration and qualification of the RINNO solution will provide REGENERA with valuable experience in the renovation of buildings with a focus on energy efficiency, the introduction of the concept of circular and sustainable economy and product-as-a-service and *ad-hoc* collaboration business models.

In addition to a potential joint exploitation of the RINNO Suite with the other partners; REGENERA will individually use all the knowledge gained, especially with regard to deep renovation business models guidelines, crowdfunding, and post-renovation behavioural incentivisation options for investment financing to enhance and improve different research activities and in order to incorporate these concepts into the portfolio of services and technologies available to its clients. In addition, REGENERA plans to extend its influence by targeting utility companies and their customers, including distributors and retailers, manufacturers and installers of energy efficiency and renewable energy technologies, facility managers, real estate companies and investors. REGENERA will target the wide base of municipality clients and associated architects, contractors and building owners in Spain and across Europe in order to identify business development opportunities. With the experience gathered through the RINNO project, REGENERA aims to develop more energy-focussed measures which will allow, for example, to explore energy efficiency measures in combination with renewable energy resources taking into account EPC concepts. Additionally, thanks to know-how generated as part of RINNO, REGENERA will be able to participate in and contribute to other EU-funded projects in the building renovation space.

All this will increase the company's competitiveness at both national and European level as all the innovations REGENERA is currently working on as part of RINNO are related to future technological advances in the field of energy efficiency, sustainability and the circular economy.

7.4 CIRCE

As a research centre, CIRCE has interest in developing know-how in collaboration with industry and in exploiting the RINNO Suite or CIRCE-developed components of the RINNO Suite after the end of the project. CIRCE aims to further exploit RINNO knowledge by assessing and supporting the implementation of the solutions considered within the project in the renovation sector. That is seeking clients who can make use of RINNO generated knowledge or solutions.

The participation of CIRCE within RINNO will lead to the publication of up to two open access scientific publications. Moreover, the knowledge acquired during the execution of the project will enable CIRCE to participate in new national and international projects related to renovation and energy efficient buildings.

7.5 EKOLAB

Knowledge regarding new and novel solutions in the deep renovation space are in demand, thus exploiting the results from RINNO of the upmost importance to retain a position as a specialised engineering consultancy within the area of energy and sustainability. The knowledge gained as part of RINNO in relation to the organisation, design and development of deep renovation projects will influence Ekolab's upcoming offering of consulting services and teaching activities. Thus, an expectation of depositing more resources for general research and work on specific projects will be incorporated. The recognition of increased investment in building knowledge, and communicating on specific services, will affect the business model and budgeting. EKOLAB expects that RINNO will provide approximately 20% of their added knowledge in renovation technologies and processes within the next four years.

Ekolab expects that the demand for a holistic approach to design, process, tools and product innovation with circular economy and biogenic products will grow significantly in the future. In Ekolab, design services and other activities will therefore, to a greater extent, be based on a broader and deeper research knowledge to identify, where necessary, alternative approaches and solutions.

Based on the experience and knowledge developed by RINNO, a larger range of alternative services can be offered to building owners and other partners. Furthermore, from an education perspective, course syllabi will be expanded to include RINNO content. Ekolab's services are therefore expected to be perceived by customers as “research-based” and therefore more robust and future-proof.

RINNO will allow Ekolab to offer new consulting and educational services both directly, by disseminating the approaches developed in RINNO, and indirectly, by adopting a research-based approach. By doing so, Ekolab will be able to expand the offering to existing customers and attract new customer groups.

Ekolab also aims to exploit the know-how and experience gained as part of the RINNO project by developing new courses promoting a holistic approach to building renovation. These courses will be of interest for existing customers but will also allow Ekolab to attract new customer groups.

The project is expected to require one to two new employees for the duration of the project but it may also generate knowledge and business opportunities that will lead Ekolab to hire one new engineer within two years after the end of the project.

7.6 Avedöre Boligselskab

Avedøre Boligselskab is the association of three social housing organisations in “Avedoøre Stationsby”, Hvidovre near Copenhagen. As one of the initial pilot sites, Avedore has gained significant knowledge

on deep renovation and the logistics of incorporating associated technologies into renovation projects. Avedore will exploit this knowledge in future renovation and new build projects. Furthermore, Avedore has extended its network of potential partners through RINNO; this network may be leveraged in future projects including Horizon Europe.

7.7 European Green Cities (EGC)

EGC will exploit RINNO's results by improving EGC's services for current and potential members in the area of deep renovation. This would ultimately increase the impacts of ECG activities in terms of energy savings in the building sector and the number of network members.

EGC has – and will continuously – inform on the results of RINNO on the website www.greencities.eu and in newsletters and on social media. Through the information, the network will be empowered in terms of energy savings in the building sector - on the RINNO experiences and new results.

It is expected that EGC, in collaboration with its network of scientific and industry partners, will use the results from the RINNO project for further development of practical deep building renovation methodologies and practices and cooperate on organising a number of seminars or webinars in Y4 of the project, when substantial achievements in the pilot sites can be shown.

7.8 Lille Métropole Habitat (LMH)

As a pilot site, LMH is exploiting RINNO IP in a very real way in Residence Sarrazins (Lille, France). LMH manages over 35,000 social accommodation units in Lille and throughout its metropolitan area. Improving the energy performance of LMH units both optimises the comfort of tenants and reduces rental charges/energy bills, and accordingly mitigates energy poverty. The lessons and experience on RINNO will inform LMH's our future plans for renovation of existing units as well as future new builds.

7.9 University of Northumbria Newcastle (UNN)

UNN aims to bring the tecno-economic tool included in the RINNO Suite to TRL 8 by the end of the project. This will be exploited as an open source technology for the end-user community to use and third party developers to develop further and adapt. The technological IP owned by UNN and the knowledge generated will be shared with BIM Academy (a joint venture between UNN and Ryder Architecture) to generate consultancy and product offerings around the management and application of novel building information management techniques and tools for building retrofit.

UNN are exploiting the results of the RINNO project in their teaching and research activities with the injection of cutting-edge approaches to the management of information and decision support tools for building retrofit in both research and teaching. These activities will enhance both UNN's teaching KPI (measured through the yearly national surveys) and their contribution to Research Excellence Framework (REF) through high quality published papers and real-world impact in the area of building retrofit. Moreover, UNN are using the RINNO activities to broaden their research activities in this area through increased bidding and grants attainment. Their bidding in areas related to management of building information has increased by 300% with the submission of an EU bid and a UK national bid. It is hoped this will be also reflected in increased research income which would further foster research, inform teaching, and strengthen their REF.

7.10 Bouygues Construction (BYCN)

RINNO will help BYCN to propose and complete faster renovation projects which would deliver higher added value for its clients and increase the company turnover while also maintaining the same workforce. BYCN plans to exploit the E-logistics and E-cockpit, on-site and off-site assembly, and the 3D printing modules of the RINNO Retrofit Manager. As part of RINNO, BYCN has the opportunity to compare different logistics processes and identify the most efficient site logistics which will greatly enhance productivity, reduce the site work duration and associated costs. This will ultimately allow BYCN to deliver more projects with lower planning duration.

The on-site and off-site assembly tool was developed to help designers and operational teams optimise their choice between onsite/offsite solutions. RINNO has provided the opportunity to finetune the selection criteria, adapt it to renovation projects and to specific site constraints and needs, and to test the tool in real demo cases. Having access to the tool will enable BYCN to tender on projects where industrialisation is required.

Finally, the 3D insulation printing tool is expected to open new market opportunities due to faster and enhanced quality implementation for large renovation projects. The lack of skilled resources and manpower for insulation is a recurrent issue for renovation projects. After productivity and speed test analysis, the possibility of deploying and commercialising this technology will be assessed including partnerships with construction equipment hire firms.

7.11 K-FLEX

K-FLEX will exploit the RINNO's results especially those relating to commercial applications by strengthening commercial partnerships with other consortium partners.

K-FLEX anticipates that RINNO will contribute directly to future employment. K-FLEX anticipates employing two new chemists and four other employees to exploit RINNO outputs. This will be a significant step forward in building an advanced R&D centre in Poland that can support the worldwide activity of the company.

7.12 VTT

The development of the Digital Twin Renovation Modelling module of the RINNO Suite represents the initial step for a Digital Twin tool that could help VTT increase its support services by creating a method and a tool for realising virtual twin simulators for clients who need an easy and reliable assessment method for evaluating different energy refurbishment solution. This will require an additional investment by VTT to bring it from TRL 5 to TRL 9.

VTT anticipate participating in 1-2 scientific publications and participating in 2-3 relevant conferences (e.g., IBPSA, International Building Performance Simulation conference, Sustainable Places) which will enhance VTT's scientific and R&D profile.

7.13 GREENSTRUCT

By participating in the RINNO project, GREENSTRUCT will be able to offer a new range of products and services for deep energy renovation projects to its current and prospective (residential and commercial) clients. The work carried out as part of RINNO will allow GREENSTRUCT to provide an easier and faster way for designing and installing Building Integrated Photovoltaics (BIPV) solutions therefore increasing the value delivered to clients and time to delivery.

RINNO will also provide GREENSTRUCT with the opportunity to showcase the application and benefits of thermochromic glass solutions therefore increasing the market awareness of these solutions and incentivise adoption.

7.14 Hellenic Institute of Passive Buildings (HPHI)

HPHI will exploit the RINNO's results both directly and indirectly. A direct exploitation will be achieved by certifying products, systems and finally the pilot building according to the EnerPHit concept, and by adding in its portfolio one certified multifamily renovation. Indirect exploitation may be realised by increasing HPHI's leadership in the respective areas of research at a national and European level. HPHI expects that the technologies validated under RINNO and the results of the deep energy renovation of the Greek pilot site will attract the interest of national government, regional and local authorities, and banks and lead to new collaborations.

It is expected that HPHI's participation in the RINNO project in conjunction with outcomes from relevant projects will enhance the research portfolio of the organisation leading to an estimated €250,000 in funding over the next five years and €150,000 in deals related to partnerships with regional and local authorities.

The increase in workload is expected to finance the placement of 2-3 full-time research assistants and post-doctoral researchers with the additional aim to advance the organisation's expertise in the field further.

7.15 National Energy Conservation Agency (NAPE)

NAPE will commercialise the approach experimented and validated as part of the RINNO project by offering sustainable renovation services for municipalities. The renovation plan implemented for the Polish pilot site will be an example to follow by other municipalities. NAPE will be able to improve its services thanks to knowledge and skills acquired through the project.

7.16 PINK

PINK aims to exploit the results of the RINNO project by searching for new opportunities for its products in at least three new export markets. There is planned technical and commercial cooperation in target export countries to support the local customers.

Pink expects a significant growth in terms of turnover (increasing the export share from 10% to over 50%) and personnel (20% increase in the number of employees) thanks to the new export activities that may result from the exploitation of RINNO.

7.17 MOTIVIAN

MOTIVIAN is a key player in designing and executing processes and in business process management. MOTIVIAN has a well-established software tool called VIA.Process which is currently used for designing and executing processes in several sectors. By participating in RINNO, MOTIVIAN will be able to adapt and test its tool in the deep renovation and construction sector and therefore providing useful knowledge and experience for entering this market. The building renovation sector is experiencing significant growth in markets where MOTIVIAN is currently operating (e.g., Greece, Cyprus and the Balkan region) and, as such, represents a valuable opportunity for MOTIVIAN to increase revenues and attract new customers.

7.18 DCU

The primary exploitation plan for DCU will be to provide the university, its graduates and the IIDB (Irish Institute of Digital Business) with a competitive advantage over other higher education institutions and specifically those outside of the EU by raising the profile of DCU through the publication of results in high quality and relevant (a) scientific and (b) trade publications and conferences. DCU anticipate being a co-author on at least 4 scholarly publications related to RINNO as well as editing the proposed open access book. These will contribute to DCU's targets for publications and citations and associated international ranking.

Furthermore, DCU will integrate technical, marketing and commercialisation research of RINNO into teaching curricula and research agendas with a view to emphasising DCU as a specialist partner in dissemination, communication and exploitation in Horizon Europe and other international and national projects.

Finally, the project's outputs will inform DCU's involvement in existing and future research projects. We anticipate participating on at least three related funded projects and direct new funding of at least €500,000 by 2025. Accordingly, this will contribute to researcher employment and future research outputs.

8. Recommendations for M25-M48 and Key Performance Indicators

8.1 Specific Exploitation and Commercialisation Recommendations for M25-M48

At M24, the majority of the RINNO consortium partners prefer to keep RINNO outputs proprietary and to exploit them either solely or with a small number of other members of the consortium. A joint exploitation between all consortium members does not seem suitable at this time. Based on the analysis and feedback presented in this report, the following is recommended:

1. Effort will be made to monitor, confidentially, RINNO consortium partners and individual researchers' preference and interest in (i) spinning out a company individually or with others in the consortium, (ii) supporting a licensee in the event of RINNO IP being licensed to a third party under a license other than an open-source license.
2. Differences in IP exploitation intent should be identified and resolved where such IP is either shared or is a dependency within a wider RINNO innovation.
3. Confirm with EKOLAB, PINK, BYCN, CERTH, MOTIVIAN and K-FLEX their intention to apply for patent protection and associated timelines and actions.
4. The specific minimum components and associated requirements for the RINNO Suite need to be defined as one single output. IPR dependencies should be identified and issues and differences in intent between partners and IPR owners should be resolved as soon as possible. Appropriately detailed technical documentation for implementing this minimum viable output including training material were appropriate should be prepared.
5. Individual partners should provide market assessments in an agreed format that validates the demand for IPR innovations reported in Individual Exploitation Plans. Supporting RINNO collateral, including a website landing pages, should be prioritised and presented to upstream and complementary market stakeholders in the market.
6. Effort should be expended by each partner to consistently quantify the business value of the RINNO IP outputs in quantitative measures and specifically in terms of cost savings, performance improvement, employment, competitive positioning, and, where possible, new revenues.
7. Effort should be expended by WP8 to validate the preliminary analysis of partners. Market assessments generated under Recommendation 6 may contribute to this validation exercise.
8. An exploitation plan or guidelines should be prepared to support open source licensing of IP outputs identified for open source licensing. Specific open source communities should be

identified and engaged. Where a discrete new open source community is proposed, for example, specific actions to build a user community around this should be identified.

8.2 Key Performance Indicators (KPIs)

KPIs establish how well RINNO is performing in its Exploitation activities. In addition to the completion of support materials and collateral for commercial and academic exploitation, performance will be measured by the overall number of outputs resulting from exploitations, primarily in Y3 and Y4 as per Table 21.

Table 21 Exploitation KPIs

Activity	KPI	Target M48	STATUS M24
Exploitation Report and IPR Protection Plan	On-time delivery of initial Exploitation Report and IPR Protection Plan and subsequent updates (D8.4)	3	1
Market/Executive Briefings	Minimum of two market briefings per annum	8	TO COMMENCE
Determinants of Energy Saving Technology Report	A report on determinants and barriers to energy saving technology adoption with minimum of 130 end user survey responses	1	WIP
RINNO Position Paper	A position paper promoting deep renovation (D8.5)	1	DUE M48
Industry Demonstration Workshops	Minimum of two dedicated Demonstration Workshops	2	1
Commercialisation Options Briefing Paper	Commercialisation Options Briefing Paper	1	VERSION 1 COMPLETE
Academic workshops	At least two academic seminars on taught or research programmes per academic partner	8	2
Stakeholder IP Briefings	At least 18 formal or informal stakeholder briefings	18	TO COMMENCE

Appendix A – Commercialisation Options Briefing Paper

This section outlines the three main commercialisation options open to individual RINNO consortium partners and the consortium as a whole i.e. licensing, to form a spin-out company, and non-equity funding. Options and variants are presented including pros and cons and critical success factors. These options should not be seen as mutually exclusive. This briefing paper is largely based on prior work completed by DCU on H2020-RECAP and extended for RINNO.

A1. Licensing

A licensing agreement is defined as "[...] a partnership between an intellectual property rights owner (licensor) and another party (licensee) who is authorized to use such rights in exchange for an agreed payment (fee or royalty)" (WIPO, 2014).

There are two primary considerations with respect to licensing. The first relates to the identification of the IP rights owner. In the case of RINNO, the IP regime is set out in the Consortium Agreement and elaborated in D8.10. The second relates to exclusivity. The licensor can grant a license with varying degrees of exclusivity. This has a significant impact on the degree to which the licensor or other members of the RINNO consortium can exploit the IP outputs of the project but also impacts the attractiveness to investors and licensees. Cameron (2010), as cited in Ozel and Penin (2016), suggests that licensing regimes for the exploitation of research can be viewed along a spectrum of exclusivity as presented in Figure 2 below.

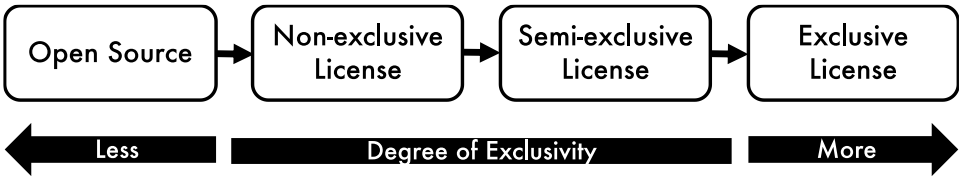

Figure 2 Degrees of Exclusivity in the Exploitation of Research Results (Ozel and Penin, 2016)

Ozel and Penin (2016) present two extremes. At one extreme, an exclusive license effectively gives a monopoly to the licensee and unless specified otherwise excludes the licensor too. Open source licensing is at the other extreme whereby anyone can use the IP and can contribute to the improvement of the IP without permission (Gambardella and Hall, 2006). The diluted forms of these licenses include non-exclusive and semi-exclusive licensing. With non-exclusive licensing, the licensor may grant a license to many different licensees including those who compete against each other. In contrast, a semi-exclusive license is one where the license gives some form of limited exclusivity, typically a geographic region or field of use. It is important to note that once IP is open-sourced or granted under a non-

exclusive or semi-exclusive license, the option of an exclusive license is no longer available. It should also be noted that there are additional variants of these licenses. For example, Fraunhofer operates two licensing variants known as carrot licensing and assertive licensing (OECD, 2013). Carrot licensing is typical of an exclusive or semi-exclusive license with the provision of necessary know-how and an agreed upfront license fee in advance of use. Assertive licensing is reactive and is a non-exclusive license following detection of an unlawful use and is therefore a form of ex-post licensing. This variant is unlikely to be available to RINNO consortium partners unless a patent is applied for and ultimately granted.

Notwithstanding these issues, the RINNO consortium together or through a spin-out company, and/or individual partners may choose to license RINNO IP to a licensee. Many commercial firms and IP brokers (e.g. Intellectual Ventures) may wish to license RINNO IP and thus avoid the time lag and/or investment associated with speculative R&D. Table 22 lists the pros and cons of licensing (OECD, 2013; Goodger & Grek, 2009; Sandelin, 2003).

Table 22 Pros and Cons of Licensing

Pros	• Royalties (including profit sharing) on specific licensed technology • Reduced risk and investment attached to realizing the technology • Social benefits related to innovation culture and ties to universities/industry • Retains and incentivises researchers • Avoidance of clash of interests between researchers and employers • Structures for licensing typically in place • Lower costs than spin-outs
Cons	• Potential returns are typically lower than spin-outs • Royalty agreements are less lucrative for lower technology readiness levels • Market valuations are difficult • Royalty payments are often contingent on success • Loss of control over IP can cause friction with researchers

The critical success factors for licensing include:

- viewing the licensing process as a marketing exercise;
- incentivising researchers to actively participate in the licensing process including the post-licensing period;
- structuring licensing in a manner that encourages technology development and use;
- prior success in licensing similar technologies or outputs by the researchers in question;
- research reputation in the field and expectation of future innovations related to the software or the field;
- the size, growth and interest in the target markets; and
- identifying and gaining the interest of target licensees and contacts within those organisations.

Previous primary research undertaken by DCU on the H2020-CloudLightning project (Lynn and Gourinovitch, 2017) noted that few exclusive licensing deals originate from Horizon 2020 ICT projects. Informants noted the need for clarity on (1) exclusivity, (2) commercial arrangements, and (3) IP considerations including dependencies. Lynn and Gourinovitch (2017) and more recently Molner et al. (2019) note that promoters of early-stage technologies (and university researchers/TTOs more specifically) tend to overestimate the commercial readiness of both the early-stage technology and the research team. Molner et al. (2019) suggest that downstream focus on end users may be resulting in a false sense of progress and may increase risk of failure whereas focussing on upstream entities away from end users can reveal and improve chances of success. Lynn and Gourinovitch (2017) also note perceived mismatches in the results focus, validation levels of prototypes, cadence, acceptable performance vs reliable performance, and licensee expectations regarding post-license support.

In the context of the RINNO consortium, it may not be possible or feasible to offer an exclusive license or even a semi-exclusive license given the ownership rights of different components by different consortium partners or the dependency on pre-existing open source licenses within the software.

Open source software may be (i) software that is made available under an open source license, (ii) software that is developed by the open source community, typically on a volunteer basis, or (iii) software that is developed as a result of an open source software process (Henkel, 2004). The first category does not preclude and often involves a company retaining intellectual property rights. The primary characteristics of open source software is that it is free for use, modification and re-distribution and is generally, not necessarily, available without a fee (Henkel, 2004). Open source licensing can also operate along a spectrum from active at one extreme to passive at the other. Passive open sourcing merely involves making the code available on an open source repository, such as Github, whereas active open sourcing represents an active form of commercialisation. Table 2 presents the pros and cons of open source software licensing (Comino and Manenti, 2011; Henkel, 2004; OECD, 2013; Goodger & Grek, 2009; Lynn and Gourinovitch, 2017).

Table 23 Pros and Cons of Open Source Software Licensing

Pros	• Wide diffusion of software and designs • Feedback from independent developers including code remediation and enhancement • Reduction in burden of software maintenance • Software may become a standard • Low cost means of software distribution and user base development • Dampens competition in the marketplace • Project sustainability • Potential revenue in premium features, consulting, complementary services and customization

	• Social benefits related to good citizenship, innovation culture and ties to the open source community
Cons	• Reduction in or loss of intellectual property rights • Commercial license fees are foregone or reduced • Managing an open-source project (including building and supporting a user base) can be time consuming, requires effort and therefore funding • Enterprise customers may perceive open source negatively or may have a policy against certain open source licenses e.g. GPL • Loss of project control (particularly where the project forks) • Loss of competitive advantage • Determining premium features/products can be difficult • Social damage related to poor quality software/coding • Economic benefits outside of the original target territory

While open source software is the most prominent application of open source licensing, there is an established and growing open design movement that applies the principles of open source licensing to physical designs. Geyer et al. (2012) define open design, a form of open source innovation, as "the openness of all accompanying documents in a product development process, with the aim of collaborative development of tangible products." Bonvoisin and Boujut (2015) note that while much of the literature and practice relates to designs of physical products, open design can equally relate to manufacturing processes. Notable open design projects include Arduino (single-board microcontrollers and microcontroller kits0, RepRap (3D-printer) and CubeFactory (self-sustaining mini-factory) (Bonvoisin and Boujut., 2015). Related to RINNO, there has been an increasing movement towards applying open design principles to related spaces including, for example, architecture (Parvin, 2013). Two commonly cited examples include Wikihouse[2] and Paperhouses[3]. Wikihouse, particular, is notable in a RINNO context due to its zero-carbon approach to design.

It is important to note that open source and open design does not preclude patenting and other IPR protections. Famously, Tesla opened sourced its patents while retaining making use of other IPR protection mechanisms including trade secrets (Wang & Peng, 2020). While this strategy means that the significant R&D investments Tesla has made cannot be directly transformed into capital flows through patent licensing, it mitigates capacity bottlenecks and ties a wider ecosystem of firms to Tesla's technology platform firmly, while at the same time insulating Tesla from lawsuits on IP grounds, trademark infringement or trade secret violation (Wang & Peng, 2020).

The critical success factors for open source licensing include:

- coordination of a strong reputable team;
- selection of an appropriate open source license and contributor agreements, if appropriate;

[2] https://www.wikihouse.cc/
[3] https://wikifactory.com/+paperhouses

- design of management and community structure including the degrees of openness and transparency;
- design of maintenance and contribution policies, guidelines and codes of conduct processes for handling grievances and disputes;
- selection and management of development methodologies with an emphasis on modularity;
- design and development of the project website, source code repository system, communication systems, and bug and feature tracking; and,
- initiation of self-organization and support processes within the community.

Again, the recent research by Lynn and Gourinovitch (2017) is informative. Attitudes towards open source licensing were mixed from an evangelical perspective at one extreme to negative at the other, and largely use-case and industry-specific. They note that some investors and companies view the open source licensing of technology as potential of limited commercialisation value i.e. either the promoters couldn't license the technology, or the technology was open sourced and effectively it can be used by anyone. Similarly, challenges in using open source software were identified not least the time and manpower to learn, use, maintain and secure the software, particularly if there was not a large active community.

While traditional licensing and open source software licensing are not necessarily mutually exclusive, they are difficult to run in parallel for similar software. Dual licensing is where a software vendor uses the open source licensing terms to induce commercial customers to select the proprietary version (Comino et al., 2007). In this case, the proprietary version, provided it uses an appropriate open source license, may benefit from the open source community and at the same time sell a proprietary version with complementary solutions, add-ons and/or additional features. Retaining management and 'ownership' of the open source community around the software is essential for dual licensing to reduce the risk of forking.

For further discussion on open source licensing and European projects, see Gomez-Diaz (2014; 2017).

A2. Spin-out Company (Equity Funding)

A spin-out company involves the establishment of a discrete company in which one or more of the consortium members become beneficial owners. For each IP output, the relevant consortium partner holding the ultimate ownership rights will license or assign the relevant IP to the company in return for shares and, possibly, royalties. Table 24 below summarises the pros and cons of a spin-out company (OECD, 2013; Goodger & Grek, 2009; Bekkers et al., 2006).

Table 24 Pros and Cons of Spin-out Companies

Pros	• Dividends on entire offering • Royalties on specific licensed technology • Higher potential returns • Social benefits related to innovation culture and ties to universities/industry • Retain and recruit staff locally • Secures commitment of participating researchers • Promotes economic growth
Cons	• Securing early stage investment difficult • Potential seed funding from CPs (incl. incubation and ongoing support) • Complete offering typically required • Key researchers may not wish to participate • Higher failure rates • CPs may no longer be in a position to exploit the IP further independently • Takes time and effort • Clash of interests between researcher duties to spin-out and original employer • University structures to support spin-outs may not be in place

There are two different types of spin-outs based on different philosophies. The first is to establish a spin-out company where the primary objectives are to continue to research and develop the projects regardless of commercial impact; this is sometimes referred to as a lifestyle spin-out. These lifestyle spinouts may act as a vehicle for continued collaboration and while they may create sustainable employment, returns to founders and economic growth are limited. In contrast, growth spin-outs are focused on the commercial exploitation of research and return on investment is the key objective.

The critical success factors for spin-outs include:

- Individual researcher characteristics and motivations;
- Technology readiness and validation;
- Organisational supports for spin-outs including relationships with relevant external organisations;
- A large addressable market;
- Entrepreneurial skills and the right mix of technical, financial, marketing and management expertise and experience;
- Availability of venture capital and investor interest in the area.

It should be noted that once spun out, small technology firms face a number of problems. Table 4 summarises the main problems identified by the literature and presented by Pellikka and Virtanen (2009).

Table 25 Commercialisation Problem Areas for Small Technology Firms Adapted from Pellikka and Virtanen (2009)

Commercial Environment	• Availability and content of innovation support services for commercialisation • Infrastructure of the local technology business environment for commercialisation • Failure to provide sufficient resources for commercialisation
Marketing	• Failure to identify the optimal functionality of the commercialised product • Failure to access, gather and exploit the market and the customer information needed for commercialisation • Failure to allocate the marketing activities for commercialisation • Failure to recognise the right timing of marketing efforts for product launch • Failure to form the close relationships with the early adopters/lead-users
Financing	• Failure to mobilise the adequate financial resources for commercialisation • Limited availability of financing during commercialisation process • Failure to manage financial resources efficiently during commercialisation • Distortion of the capital structure for commercialisation
Management	• Failure to set the measures of commercialisation • Failure to acquire and manage multi-functional resources for commercialisation • Lack of marketing and finance experience needed for commercialisation • Failure to form collaboration and partnerships for commercialisation-related R&D • Failure to exploit the new market opportunities rapidly with the product under commercialisation

A3. Non-equity Funding

A third commercialisation option is for one or more consortium partners to apply for non-equity funding to develop the overall RINNO Suite or other subsidiary IP outputs to a higher technology readiness level. Such activity is typically funded by government and distributed through enterprise development or research agencies and typically falls in to three categories – proof-of-concept, pre- seed and seed funding as outlined in Table 5 (Rasmussen and Sorheim, 2012).

Table 26 The Main Characteristics of Different Types of Government University Spin-off (USO) Funding

(Rasmussen and Sorheim, 2012)

	Proof-of-Concept	Pre-seed	Seed
Goal	Reduce the technological uncertain	Reduce the organisational uncertainty of the project by preparing the project organisationally for further investment	Reduce the investment risk associated with the project by providing funding that accept a higher risk than most private actors
Approach	Demand-side: Increase the attractiveness of USOs for investors	Demand-side	Supply-side: Increase the supply of early-stage funding
Type of government support	Usually 100% grant-based	Usually grant based but sometimes convertible to equity	Usually equity or loans
Manager of funds	Usually government agency	Varies, but often regional agent	Usually private agent or independent government unit
Funding decision	Usually by application and panel review, similar to research funding	Varies, but usually made at regional level	Investment decision accepting high risk
Type of activity supported	Technology development at project level	Market and management development by entrepreneurs or consultants	Venture launch
Main criteria for funding	Market potential of technology	Combination of individual and project characteristics	Growth potential of the new venture
Anticipated outcome	USO or license to existing firm	USO	High-growth USO

A4. Other Considerations

A4.1 Crowdfunding

Crowdfunding enables entrepreneurs to attract external finance and develop their business idea by directly involving a large number of funders as active consumers, investors, or both (Belleflamme et al., 2014). Since its emergence in 2010, crowdfunding has expanded in terms of the volume, variety and value of transactions to which it is applied (Lawton and Marom, 2010). According to Technavio (2022), the global crowdfunding market is expected to increase by more than USD 230 billion from 2021 to 2026, at a CAGR of 16.81%. More recently researchers have sought funding for research projects using crowdfunding and specialists crowdfunding platforms for scientific research are emerging including Experiment.com, Crowd.Science, USeed and Consano. These sites vary in terms of their requirements in return for investment, but it is primarily in the form of an acknowledgement. Research crowdfunding are typically small amounts – USD 2,500 to USD 10,000. However, the Beckley Foundation raised

US$80,000 for funding an fMRI project.[4] Researchers report greater success on traditional crowdfunding platforms. For example, Professor Jordan Peterson of the University of Toronto raised CAD 195,230 from 2,693 backers using the IndieGoGo platform[5]. It should be noted that Kickstarter, the highest profile platform, does not allow funding for research projects although this rule has been circumvented by some researchers. Crowdfunding may be a novel option for follow-on funding to support a spin-out, commercialisation or an open-source project. Crowdfunding is further explored in RINNO through WP7.

A4.2 Initial Coin Offerings/Security Token Offerings

A more recent trend in project/business financing is the issuance of digital tokens which provide investors some sort of rights in relation to the project. There are three main type of tokens (Tasca, 2019):

- Payment tokens which are essentially cryptocurrencies that are used as means of payment or value transfer;
- Utility tokens that allow token holders to access a specific digital application/service;
- Asset/Debt tokens which represent for the investor assets such as a debt or equity.

Initial token offerings, typically referred to as Initial Coin Offerings (ICOs), are, at first glance, similar to crowdfunding campaigns as they represent open calls for funding. However, they have critical differences in that they are completely disintermediated, typically are of scale orders of magnitude larger in terms of participants and value and are established on blockchain-based smart contracts.

Although token offerings represent a recent phenomenon, more than USD 31 billion has been raised through ICOs between 2013 and 2019, with exponential growth year over year (PwC, 2020). From a project promoter's perspective, one of main benefits of token offerings is the opportunity of attracting both capital and users, particularly with the issuance of utility tokens, see for example, Filecoin. This is particularly beneficial for platforms' promoters as reaching a critical mass of users is paramount for the success of the project. Unsurprisingly, platform-based businesses represent the majority of completed token offerings so far, followed by projects related to cryptocurrencies (Icobench, 2019). As this type of fundraising matures, the number of initiatives across other industries is expected to grow, particularly in the IT sector. One notable recent example of a successful ICO to drive the growth of an IT platform is Filecoin. Launched in August 2017, Filecoin raised in excess of US$200 million in less than 30 days to fund the development of a new blockchain-based system (the Filecoin protocol) to host a peer-to-peer decentralized storage market. The Filecoin protocol was designed to be completely automated

[4] https://slate.com/technology/2015/04/petridish-experiment-and-walacea-are-the-kickstarters-of-science-funding-but-is-the-science-they-fund-legit.html
[5] https://www.indiegogo.com/projects/support-professor-jordan-peterson-s-research#/

and, being based on public blockchain, it needed a large number of active nodes from day one in order to be secure. By issuing utility tokens, the founders were able to tap into future users who were willing to support the development of the platform, to use it when the system was live, and to share in the success of the platform itself.

Although very attractive from a financial standpoint, token offerings face two main challenges related to lack of legitimacy and ambiguous regulation which might discourage established investors from participating. The former is mostly due to the fact that more than 80% of past ICO initiatives have been deemed to be scams; as such, many investors still look at token offerings with suspicion. This is partially connected to the second challenge mentioned above. ICOs were, in fact, completely unregulated at the beginning and still are in many countries. As such, investor protection is non-existent or, at least, very limited. Some regulators have recently provided clearer frameworks by making asset/debt tokens comparable to more standard securities like debt or equities. This has enabled the development of more legitimate, transparent and regulated token offerings (also known as Security Token Offerings (STOs)). STOs are particularly attractive for profit- driven, established investors who are looking for acquiring a stake in these innovative initiatives, and particularly for issuing asset-backed tokens (Lynn & Rosati, 2021). A notable and relevant example of such an STO in the context of RINNO is Aspen Digital, a tokenised asset offering (TAO) that was launched by Templum Markets in 2018 where each token, called Aspen Coin, represented, through indirect ownership, one share of common stock in the St. Regis Aspen Resort in Aspen, Colorado. In effect, each token was backed by the real estate asset in the Resort. Within two months from launch, Aspen Digital was able to sell 18.9% of the St. Regis Aspen Resort ownership and raise US$18 million (Carroll, 2018). Token offerings, either in the form of an ICO or of an STO, may be represent a further option to fund a future spin-out company and the development of an open source, sharing ecosystem.

A4.3 Loans

While such funding may not have substantial, if any, appetite from the researchers, a spin-out may be funded by loans sourced from traditional financial institutions or peer-to-peer lending platforms. It should be noted that convertible loans for venture funding are included in non-equity funding.

A4.4 Patent/IP Aggregators

As discussed earlier, IP aggregators may be a potential avenue for funding from a licensing perspective or indeed further funding for research. However, given that the consortium partners previously indicated an unwillingness to apply for a patent or believe a patent is likely to be granted, this avenue is unlikely to be pursued.

A4.5 Independent or Together

It should be noted that RINNO CPs may choose to pursue a spin-out and/or licensing as independent entities or together. For example, it is feasible for the RINNO consortium partners to (i) enter into a new exploitation consortium comprising all or a subset of consortium partners, or (ii) to spin-out a company with each consortium member as a shareholder, with a goal of licensing or otherwise commercialising the RINNO intellectual property. Similarly, the consortium might establish a foundation to seek funds to sustain and manage a RINNO open source/design project. While (i) above is rare, it is not unknown. The UK LearnOnline Consortium was formed by the original contract developers for the Becta National Learning Network project in the UK. As part of the agreement with Becta, the development firms retained the commercial intellectual property rights in the content that they developed for outside of the UK. These firms, competitors for bespoke e-learning contracts, formed a consortium into which they initially paid fees and were subsequently funded from royalties on sales. Each member was entitled to license the total library at an agreed fee level and in addition, an independent agent was appointed to sell the library. The consortium has been active for over 12 years.

ABOUT RINNO

RINNO is a four-year EU-funded research project that aspires to deliver greener, bio-based, less energy- intensive from a life cycle perspective and easily applicable building renovation elements and energy systems that will reduce the time and cost required for deep energy renovation, while improving the building energy performance. Its ultimate goal is to develop, validate and demonstrate an operational interface with augmented intelligence and an occupant-centered approach that will streamline and facilitate the whole lifecycle of building renovation.

For more information, please visit **https://rinno-h2020.eu/**

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REFERENCES

Bekkers, R., Gilsing, V. and Van Der Steen, M., 2006. Determining Factors of the Effectiveness of IP-based Spin-offs: Comparing the Netherlands and the US. The Journal of Technology Transfer, 31(5), pp.545- 546.

Belleflamme, P., Lambert, T., & Schwienbacher, A., 2014. Crowdfunding: Tapping the right crowd. Journal of Business Venturing, 29(5), 585-609.

Bonvoisin, J., and Boujut, J. F., 2015. Open design platforms for open source product development: current state and requirements. In DS 80-8 Proceedings of the 20th International Conference on Engineering Design (ICED 15) Vol 8: Innovation and Creativity, Milan, Italy, 27-30.07. 15 (pp. 011-020).

Cameron, D. M., 2010. Cameron's Canadian Patent and Trade Secrets Law. Toronto: Donald M. Cameron, Bereskin & Parr LLP.

Carroll, R., 2018. In $18 million deal, nearly one-fifth of St. Regis Aspen sells through digital tokens. Aspen Times. https://www.aspentimes.com/trending/in-18-million-dealnearly-one-fifth-of-st-regis-aspen-sells-through-digital-tokens/.

Chansomsak, S. and Vale, B., 2009. The roles of architects in sustainable community development. Journal of Architectural/ Planning Research and Studies (JARS), 6(3), pp.107-136.

Comino, S. and Manenti, F.M., 2011. Dual licensing in open source software markets. Information Economics and Policy, 23(3-4), pp.234-242.

Gambardella, A. and Hall, B.H., 2006. Proprietary versus public domain licensing of software and research products. Research Policy, 35(6), pp.875-892.

Geyer, P., 2012. Systems modelling for sustainable building design. Advanced Engineering Informatics, 26(4), pp.656-668.

Goodger B. & Grek T., 2009. Options Available When Commercialising University IP. In Intellectual Asset Management Magazine, March-April 2009.

Henkel, J., 2004. Open source software from commercial firms–tools, complements, and collective invention. Zeitschrift für Betriebswirtschaft, 4, pp.1-23.

ICOBench, 2019. Digest of the year 2019. Available at: https://icobench.com/thebench-post/628-digest-of-the-year-2019 (retrieved May 2022).

Jensen, R. and Thursby, M., 2001. Proofs and prototypes for sale: The licensing of university inventions. American Economic Review, 91(1), pp.240-259.

Kingston, W., 2001. Meeting Nelson's Concerns about Intellectual Property. Intellectual property, 12, p.15.

Lawton, K. and Marom, D., 2010. The crowdfunding revolution: Social networking meets venture financing. Thecrowdfundingrevolution.com.

Lynn, T. and Gourinovitch, A., 2017. D8.1.3 Research Report on Commercialisation Opportunities. H2020-CloudLighting.

Lynn, T., and Rosati, P., 2021. New sources of entrepreneurial finance. Digital Entrepreneurship, pp. 209-231.

Molner, S., Prabhu, J.C. and Yadav, M.S., 2019. Lost in a universe of markets: Toward a theory of market scoping for early-stage technologies. Journal of marketing, 83(2), pp.37-61.

Nelson, R.R. and Winter, S.G., 1982. The Schumpeterian tradeoff revisited. The American Economic Review, 72(1), pp.114-132.

OECD, 2013. Commercialising Public Research: New Trends and Strategies. Paris: OECD.

Özel, S.Ö. and Pénin, J., 2016. Exclusive or open? An economic analysis of university intellectual property patenting and licensing strategies. Journal of Innovation Economics & Management, (3), pp.133-153.

Parvin, A., 2013. Architecture (and the other 99%): open-source architecture and design commons. Architectural design, 83(6), 90-95.

Pellikka, J. and Virtanen, M., 2009. Problems of commercialisation in Small Technology-based Firms. International Journal of Entrepreneurship and Innovation Management, 9(3), pp.267-284.

Penin, J., 2010. On the consequences of patenting university research: Lessons from a survey of French academic inventors. Industry and Innovation, 17(5), pp.445-468.

PwC, 2020. 6th ICO/STO Report. Available at: https://www.pwc.com/ee/et/publications/pub/Strategy&_ICO_STO_Study_Version_Spring_2020.pdf.

Rasmussen, E. and Sørheim, R., 2012. How governments seek to bridge the financing gap for university spin- offs: Proof-of-concept, pre-seed, and seed funding. Technology Analysis & Strategic Management, 24(7), pp.663-678.

Sandelin, J., 2003. Success factors in university technology transfer through patenting and licensing. InnovationMatters, 15(15), 10.

Tasca, P., 2019. Token-based business models. In Disrupting finance (pp. 135-148). Palgrave Pivot, Cham.

Technavio, 2022. Crowdfunding Market by Type and Geography - Forecast and Analysis 2022-2026. Available at: https://www.technavio.com/report/crowdfunding-market-industry-service-analysis.

Wang, J., and Peng, X., 2020. a study of patent open source strategies based on open innovation: The case of tesla. Open Journal of Social Sciences, 8(07), 386.