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Report No: PAD4577

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US\$100 MILLION

TO THE

REPUBLIC OF PERU

FOR THE

STRENGTHENING PERU'S NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION
SYSTEM PROJECT

January 27, 2022

Finance, Competitiveness and Innovation Global Practice
Latin America and Caribbean Region

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CURRENCY EQUIVALENTS

(Exchange Rate Effective November 30, 2021)

Currency Unit = Peruvian Soles
Nuevos (PEN)

PEN 4.07 = US\$1

FISCAL YEAR

January 1 - December 31

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ABBREVIATIONS AND ACRONYMS

CE	Entrepreneurial Capital (<i>Capital Emprendedor</i>)
CITEs	Productive Innovation and Technology Transfer Centers (<i>Centros de Innovación Productiva y Transferencia Tecnológica</i>)
COFIDE	Financial Corporation of Development (<i>Corporación Financiera de Desarrollo SA</i>)
CONCYTEC	National Science, Technology and Innovation Council (<i>Consejo Nacional de Ciencia, Tecnología e Innovación</i>)
CPF	Country Partnership Framework
EBT	Technology-Based Company (<i>Empresa de Base Tecnológica</i>)
FINCYT	Fund for Innovation, Science and Technology (<i>Fondo para la Innovación, la Ciencia y la Tecnología</i>)
IDB	Inter-American Development Bank
IGP	Geophysical Institute of Peru (<i>Instituto Geofísico del Perú</i>)
INAIGEM	National Institute for Research in Glaciers and Mountain Ecosystems (<i>Instituto Nacional de Investigación en Glaciares y Ecosistemas de Montaña</i>)
INIA	National Institute of Agrarian Innovation (<i>Instituto Nacional de Innovación Agraria</i>)
INEI	National Statistics and Informatics Institute (<i>Instituto Nacional de Estadística e Informática</i>)
INS	National Institute of Health (<i>Instituto Nacional de Salud</i>)
IVAI	Competitiveness Reinforcement Initiatives for Productive Innovation (<i>Iniciativas de Vinculación Academia – Industria</i>)
IPEN	Peruvian Institute of Nuclear Energy (<i>Instituto Peruano de Energía Nuclear</i>)
IUP	Innovation Upgrading Plan
MSTQ	Metrology, Standards, Testing, and Quality
NIS	National Innovation System
NPDSTI	National Policy for the Development of Science, Technology and Technological Innovation
NKTC	National Knowledge Transfer Center
OECD	Organisation for Economic Co-operation and Development
OTT	Office of Technology Transfer
PNCP	National Competitiveness and Productivity Plan (<i>Política Nacional de Competitividad y Productividad</i>)
PNIA	National Agricultural Innovation Project (<i>Programa Nacional de Innovación Agraria</i>)
PNIPA	National Program for Innovation in Fisheries and Aquaculture (<i>Programa Nacional de Innovación en Pesca y Acuicultura</i>)
PRI	Public Research Institute
PROCIENCIA	National Program of Scientific Research and Advanced Studies (<i>Programa Nacional de Investigación Científica y Estudios Avanzados</i>)
PRONABEC	National Program of Scholarships and Educational Credit (<i>Programa Nacional de Becas y Crédito Educativo</i>)
RENIEC	National Identification and Civil Status Registry (<i>Registro Nacional de Identificación y Estado Civil</i>)
SINACYT	National System of Science, Technology and Technological Innovation (<i>Sistema Nacional de Ciencia y Tecnología e Innovación Tecnológica</i>)

SINACTI	National Science, Technology and Innovation System (<i>Sistema Nacional de Ciencia, Tecnología e Innovación</i>)
SINEACE	National System of Evaluation, Accreditation and Certification of Educational Quality (<i>Sistema Nacional de Evaluación, Acreditación y Certificación de la Calidad Educativa</i>)
SOP	Series of Projects
SUNEDU	National Higher Education University Superintendency (<i>Superintendencia Nacional de Educación Superior Universitaria</i>)
STI	Science, Technology, and Innovation
STIS	Strengthening the Science, Technology, and Innovation System in Peru project
TISC	Technology and Innovation Support Center
WBG	World Bank Group
WIPO	World Intellectual Property Organization

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DATASHEET

BASIC INFORMATION

Country(ies)	Project Name	
Peru	STRENGTHENING PERU'S NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM	
Project ID	Financing Instrument	Environmental and Social Risk Classification
P176297	Investment Project Financing	Moderate

Financing & Implementation Modalities

<input type="checkbox"/> Multiphase Programmatic Approach (MPA)	<input type="checkbox"/> Contingent Emergency Response Component (CERC)
<input checked="" type="checkbox"/> Series of Projects (SOP)	<input type="checkbox"/> Fragile State(s)
<input type="checkbox"/> Performance-Based Conditions (PBCs)	<input type="checkbox"/> Small State(s)
<input type="checkbox"/> Financial Intermediaries (FI)	<input type="checkbox"/> Fragile within a non-fragile Country
<input type="checkbox"/> Project-Based Guarantee	<input type="checkbox"/> Conflict
<input type="checkbox"/> Deferred Drawdown	<input type="checkbox"/> Responding to Natural or Man-made Disaster
<input type="checkbox"/> Alternate Procurement Arrangements (APA)	<input type="checkbox"/> Hands-on Enhanced Implementation Support (HEIS)

Expected Approval Date	Expected Closing Date
17-Feb-2022	30-Dec-2027

Bank/IFC Collaboration

No

Proposed Development Objective(s)

The objective of the Project is to improve science, technology, and innovation services in targeted Strategic Areas and regions.



Components

Component Name	Cost (US\$, millions)
1: Strengthening SINACTI's institutions and governance to bolster innovation in Peru	1.34
2. Capacity development for the generation of knowledge in Strategic Areas	72.53
3. Strengthening Industry-academia linkages to accelerate technology transfer and science-based business innovation	23.00
4. Project Management and Monitoring & Evaluation	3.13

Organizations

Borrower:	Republic of Peru
Implementing Agency:	Programa Nacional de Investigación Científica y Estudios Avanzados (PROCIENCIA)

PROJECT FINANCING DATA (US\$, Millions)

SUMMARY

Total Project Cost	125.00
Total Financing	125.00
of which IBRD/IDA	100.00
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Bank for Reconstruction and Development (IBRD)	100.00
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Non-World Bank Group Financing

Counterpart Funding	25.00
National Government	25.00

INSTITUTIONAL DATA



Practice Area (Lead)

Finance, Competitiveness and Innovation

Contributing Practice Areas

Education

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	● Substantial
2. Macroeconomic	● Moderate
3. Sector Strategies and Policies	● Moderate
4. Technical Design of Project or Program	● Moderate
5. Institutional Capacity for Implementation and Sustainability	● Substantial
6. Fiduciary	● Substantial
7. Environment and Social	● Moderate
8. Stakeholders	● Low
9. Other	
10. Overall	● Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

Yes No

Does the project require any waivers of Bank policies?

Yes No



Environmental and Social Standards Relevance Given its Context at the Time of Appraisal

E & S Standards	Relevance
Assessment and Management of Environmental and Social Risks and Impacts	Relevant
Stakeholder Engagement and Information Disclosure	Relevant
Labor and Working Conditions	Relevant
Resource Efficiency and Pollution Prevention and Management	Relevant
Community Health and Safety	Relevant
Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Not Currently Relevant
Biodiversity Conservation and Sustainable Management of Living Natural Resources	Relevant
Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Relevant
Cultural Heritage	Not Currently Relevant
Financial Intermediaries	Not Currently Relevant

NOTE: For further information regarding the World Bank’s due diligence assessment of the Project’s potential environmental and social risks and impacts, please refer to the Project’s Appraisal Environmental and Social Review Summary (ESRS).

Legal Covenants

Sections and Description

Schedule 2, Section I.A.1 of the Loan Agreement: Project Implementation Team

The Borrower shall ensure that PROCIENCIA with technical support from CONCYTEC, shall: (a) maintain, until the completion of the Project, a team (the “PIT”) responsible for the management, coordination, supervision, monitoring and evaluation of the Project, including with respect to all procurement, financial management, environmental and social requirements related to the Project; and (b) no later than thirty (30) days after the Effective Date hire (to the extent such staff are not already in place), and thereafter maintain, key staff in the PIT with functions, experience, responsibilities and qualifications acceptable to the Bank, as described in the POM, including, inter alia, a Project coordinator, an adjunct Project coordinator, at least three technical experts, two procurement specialists, one financial management specialist, one budget and planning specialist, one legal specialist, and one socio-environmental specialist, to support the implementation of the Project.



Sections and Description

Schedule 2, Section I.B of the Loan Agreement: Sub-Projects.

1. The Borrower, through PROCENCIA, shall issue calls for proposals, competitively select proposals and grantees, and make Grants to Eligible Grantees for the implementation of Sub-Projects in accordance with the eligibility, selection, and technical criteria and procedures acceptable to the Bank set forth in the POM (including the applicable Specific Operational Manual(s)) and with the applicable requirements of the ESMF.
2. After having selected and approved a proposal for a Sub-Project presented by an Eligible Grantee in accordance with the POM, and for the purpose of carrying out such Sub-Project, the Borrower through PROCENCIA shall enter into an agreement with the relevant Eligible Grantee ("Grant Agreement"), to be prepared based on the relevant model form (and otherwise on terms and conditions) approved by the Bank and included in the POM.
3. The Borrower, through PROCENCIA, shall ensure that each Grant Agreement includes, inter alia, the following provisions:
 - (a) the Borrower, through PROCENCIA, shall obtain rights adequate to protect its interests and those of the Bank;
 - (b) the provisions required to be included pursuant to the ESCP in relation to the applicable Sub-Project, in accordance with the ESMF and LMP, including, inter alia, the requirement to prepare and implement any required ESMPs during the implementation of the Sub-Project, and to obtain any necessary environmental, social, health and safety permits, licenses and authorizations; and
 - (c) in the case of an Institutional Alliance Sub-Project, with respect to any Scholarship for study at a doctoral program supported by the respective Institutional Alliance Grant, the obligation of the Eligible Public University that is party to such Grant Agreement to use proceeds of the relevant Institutional Alliance Grant paid to it by PROCENCIA to satisfy the enrollment fees and tuition for such Scholarship.
4. The Borrower, through PROCENCIA, shall exercise its rights and carry out its obligations under each Grant Agreement in such manner as to protect the interests of the Borrower, through PROCENCIA, and the Bank and to accomplish the purposes of the Project.
5. Except as the Bank shall otherwise agree, the Borrower shall ensure that PROCENCIA shall not assign, amend, abrogate, waive, terminate or fail to enforce any Grant Agreement or any of its provisions.

Sections and Description

Schedule 2, Section I.C of the Loan Agreement: Scholarships.

1. The Borrower, through PROCENCIA, shall issue calls for applications from, competitively select, and award scholarships to, Eligible Students in accordance with the eligibility, selection, and technical criteria and procedures acceptable to the Bank, set forth in the POM (including the applicable Specific Operational Manual) and with the applicable requirements of the ESMF.



2. Upon the approval of a Scholarship under Part 2.1.2 of the Project, the Borrower through PROCENCIA shall enter into an agreement with the relevant Eligible Student (a "Student Agreement"), to be prepared based on the relevant model form (and otherwise on terms and conditions) approved by the Bank and included in the POM.

3. The Borrower through PROCENCIA:

(a) shall exercise its rights and carry out its obligations under each Scholarship Agreement and Student Agreement, in such a manner as to protect the interests of the Bank and the Borrower, through PROCENCIA, and to accomplish the purposes of the Loan; and

(b) except as the Bank shall otherwise agree, shall not assign, amend, abrogate, terminate, waive or fail to enforce any Scholarship Agreement or Student Agreement (or any provision thereof).

Sections and Description

Schedule 2, Section I.D of the Loan Agreement: Project Operational Manual and Specific Operational Manual

1. The Borrower through PROCENCIA shall carry out the Project in accordance with the POM.

2. Except as the Bank shall otherwise agree, the Borrower through PROCENCIA shall not amend or waive the POM, or any provision thereof, or permit any such provision to be amended or waived.

3. In case of any conflict between the provisions of the POM and the provisions of this Agreement, the provisions of this Agreement shall prevail.

4. Before issuing any call for proposals or applications for a Sub-Project, Scholarship, or other Project activity subject to competitive selection, the Borrower through PROCENCIA shall co-prepare with CONCYTEC, adopt, and incorporate in the POM a Specific Operational Manual including the procedures for that Sub-Project, Scholarship or other Project activity, in form and substance satisfactory to the Bank.

Conditions

Type	Financing source	Description
Effectiveness	IBRD/IDA	(a) The Project Operational Manual has been prepared by the Borrower through PROCENCIA in coordination with CONCYTEC and adopted by the Borrower through PROCENCIA, in form and substance satisfactory to the Bank. (Article IV, 4.01 (a) of the Loan Agreement.)
Effectiveness	IBRD/IDA	(b) The Borrower through PROCENCIA has prepared, adopted and publicly disclosed on its website the Labor Management Procedures in form and substance acceptable to the Bank. (Article IV, 4.01 (b))



		of the Loan Agreement.)
Type Effectiveness	Financing source IBRD/IDA	Description (c) The Borrower through PROCIENCIA has prepared, adopted and publicly disclosed on its website the grievance mechanisms referred to in the ESCP in form and substance acceptable to the Bank. (Article IV, 4.01 (c) of the Loan Agreement.)
Type Effectiveness	Financing source IBRD/IDA	Description (d) The Borrower has provided evidence satisfactory to the Bank that PROCIENCIA has initiated operations in accordance with the fifth final supplementary provision of Supreme Decree No. 051-2021-PCM creating PROCIENCIA (i.e., that the FONDECYT-PROCIENCIA merger process has concluded) and has perfected the merger process by finalizing its budget and ability to make payments. (Article IV, 4.01 (d) of the Loan Agreement.)
Type Disbursement	Financing source IBRD/IDA	Description Notwithstanding the provisions of Part A above, no withdrawal shall be made for payments made prior to the Signature Date, except that withdrawals under Category 3 of up to an aggregate amount not to exceed \$20,000,000 may be made for payments made prior to this date but on or after May 19, 2021 (but in no case more than one year prior to the Signature Date), for Eligible Expenditures. (Schedule 2, Section III.B.1 of the Loan Agreement.)



I. STRATEGIC CONTEXT

A. Country Context

- 1. Despite a solid macroeconomic policy that has favored growth and poverty reduction over the past two decades, Peru's economy remains highly dependent on a limited number of extractive activities.**¹ Driven by structural reforms and prudent macroeconomic policies,² real GDP growth rate averaged over 4.8 percent between 2000 and 2019, above the average for Latin America and the Caribbean (LAC).³ As a result, the poverty rate fell from 59 percent in 2004 to 21 percent in 2019.⁴ However, even before the COVID-19 pandemic, GDP growth rates had slowed to a little over 3 percent per year since 2014, in part due to lower international commodity prices and contracting external demand. In the wake of the economic crisis brought on by the COVID-19 pandemic, GDP contracted 11.1 percent in 2020, one of the highest drops among the major economies of Latin America.⁵ Unemployment has increased from 3.6 percent in the second quarter of 2019, to 8.8 percent in the same period of 2020. Given the continued volatility in global commodity prices, Peru's growing dependence on extractive industries, which grew by 50 percent as share of GDP over the past 30 years, presents a substantial risk to sustainable economic recovery and growth and underscores the importance of leveraging research and development (R&D) and innovation to achieve greater productivity and spillover effects in these sectors, as well as a more robust economic diversification.
- 2. Economic diversification in Peru has been increasing over the past decade, but at a slow pace, with agriculture products and tourism services increasingly contributing to Peru's exports basket.** The mining sector continues to dominate the economy representing 60 percent of total country exports, 60 percent of foreign exchange, and 12 percent of GDP in 2019.⁶ However, agricultural exports have expanded from 0.4 percent of GDP in 2001 to an estimated 2.7 percent of GDP in 2019. Seasonal exports to the Northern Hemisphere of high-value fresh fruits and vegetables (mostly grapes, avocados, blueberries, and asparagus) totaled US\$2.5 billion or 1.2 percent of GDP, and Peru is now among the top global exporters of some of these products. Travel and tourism exports have also increased fivefold from US\$837 million in 2000 to over US\$4.5 billion in 2018. A much smaller but rapidly growing sector is pharmaceuticals, medicinal chemical substances, and botanical products. In 2018, production of those products grew by 4 percent, but exports grew by 22.6 percent compared to the previous year totaling US\$76.3 million. These exports are concentrated in high value-added products and services, which require significant investments in technology, innovation, and upgrading in skills.
- 3. Increasing productivity gains and competitiveness in tradable sectors remains critical for export diversification and can directly contribute to the creation of better jobs in the Peruvian economy.** Mining and manufacturing are the most productive sectors of the economy, but represent only 1 and 9 percent of total employment, respectively.⁷ In contrast, agriculture and commerce, despite accounting for the highest shares of employment, are the sectors with the lowest productivity. Significant differences in agricultural productivity growth continue

¹ Peru, with a population of about 33 million, is located in western South America. It has a diverse geography combining arid coastal plains, Andes mountains, and Amazon rainforest.

² World Bank Group, Peru Overview.

³ World Bank Group, Macro Poverty Outlook Update June 2020.

⁴ Peru Policy Notes: <https://documents1.worldbank.org/curated/en/330961630045157214/pdf/Repensar-el-Futuro-del-Peru-Notas-de-Politica-para-Transformar-al-Estado-en-un-Gestor-de-Bienestar-y-Desarrollo.pdf>

⁵ World Bank (2020). Global Economic Prospects, June 2020.

⁶ Sociedad Nacional de Minería, Petróleo y Energía. and Gerencia de Información y Análisis Económico Gerencia Central de Estudios Económicos, Actividad Económica Febrero 2020. Abril 2020.

⁷ This result must be interpreted with caution given that mining and manufacturing are also the most capital-intensive sectors.



to exist between regions and between categories of producers, and overall agricultural productivity in Peru remains low compared to other countries, despite the very significant surges in the past decade in the export of high-value and innovation intensive products. In the larger economy, productivity also varies substantially across firm size with the productivity of micro, small, and medium enterprises estimated to be 6, 16, and 50 percent, respectively, that of large firms in Peru, differentials that are greater than those observed in other LAC and OECD countries.⁸

4. **Limited productivity gains are explained in part by limited technology adoption and innovation development in tradable sectors.** Peruvian firms invest on average 2.5 percent of their sales in innovation, whereas their peers in Chile invest 3.5 percent. Total factor productivity of innovative firm is 50 percent higher than that of non-innovative firms in LAC, compared to a difference of only 20 percent in OECD countries.⁹ Moreover, technology adoption (acquired through licenses of new technology and imported capital goods), which is a way to move closer to the innovation frontier, is scarce. Only 7 percent of Peruvian firms have licensed technology from abroad, half the LAC region average and 2.5 times less than in OECD countries. One explanatory factor is the inability of SMEs to embrace new skills and new technology. Data show that innovating firms are five years older and employ 75 percent more workers, on average. Young and small firms are particularly constrained by product market competition and innovation issues and uneven access to innovation inputs.¹⁰
5. **High-skilled work force constraints are also impacting competitiveness and productivity.** Peru's Human Capital Index increased faster than most of its neighboring countries¹¹ during the last decade, but this increase in the Index has been mainly due to improvement in basic education and reduced chronic malnutrition or stunting. However, other aspects of human capital, such as skills development, are still weak, leading to a relatively high deficit in skilled workforce in Peru compared to other countries.¹² Women, in particular, despite being more likely to attend university than men, are less likely to study STEM (science, technology, engineering, and math) fields¹³ (science, technology, engineering, and math) or to pursue a doctorate program. Stereotypes and biases are important drivers of gender gaps in STEM, and lead to similar disparities in the labor market – women who study STEM fields are less likely to enter STEM careers and tend to exit them sooner, thus limiting women's participation in the most trade-intensive sectors.¹⁴ Early evidence suggests that female labor participation has declined during COVID.
6. **Finally, limited technology adoption and innovation are also constraining the country's ability to address its sizable social and environmental challenges, such as ensuring adequate access to health services, reducing regional disparities, and adapting to and mitigating climate change.** Peru has been extremely hard-hit by the COVID-19 pandemic – with 150 deaths per 100,000 population, it is currently among the countries with the highest death toll from the pandemic – underscoring deficiencies in epidemiological surveillance and public health preparedness.¹⁵ Peru also suffers from a substantial imbalance in the geographic concentration of economic activity, productivity, population, and institutional capacity.¹⁶ Additionally, Peru is highly vulnerable to climate change. Observed and projected climate change impacts include rising temperatures, extreme

⁸ ECLAC, 2013

⁹ Grazzi, M. & Pietrobelli, C. (Eds.). 2021. Firm Innovation and Productivity in Latin America and the Caribbean: The Engine of Economic Growth. Washington, DC: Interamerican Development Bank.

¹⁰ World Bank. 2015. Peru – Building on Success: Boosting Productivity for Faster Growth. Washington, DC: World Bank Group

¹¹ From 0.55 to 0.61 during the last 10 years. Reference: Human Capital Project, The World Bank, 2020.

¹² Manpower Group. (2013). "2014 Talent Shortage Survey". <http://www.manpowergroup.com/talent-shortage-explorer/>

¹³ World Bank. 2020. The Equality Equation: Advancing the Participation of Women and Girls in STEM. Washington, DC: WBG

¹⁴ <https://www.worldbank.org/en/topic/trade/publication/women-and-trade-the-role-of-trade-in-promoting-womens-equality>

¹⁵ <https://coronavirus.jhu.edu/data/mortality>. Retrieved March 11, 2021.

¹⁶ Banco Interamericano de Desarrollo, Estimación del PIB Departamental y Análisis de la Desigualdad Regional en el Perú: 1795-2017.



precipitation, and more frequent and severe occurrences of climate and natural disasters, including flooding and droughts linked to the recurrent El Niño and El Niño Costero phenomena.¹⁷ These climate shocks are expected to have significant economic impacts in Peru— by 2100, losses related to climate change could range between 11.4 percent and 15.4 percent of national GDP.¹⁸ Therefore, developing knowledge, research, and innovation solutions to climate change mitigation and adaptation is key to building economic and physical resilience to climate change impacts, finding innovative ways to reduce emissions, and identifying future approaches for inclusive, low-carbon, and climate resilient growth. Given that public systems, infrastructure, and services can be negatively impacted in the event of climate disasters, they would also benefit from research and innovation to mitigate risks and impacts. As one example, the strengthening of digital services within government is important to allow it to continue functioning and providing services in the event of climate-induced shocks and disasters, thus improving resilience.

B. Sectoral and Institutional Context

7. **Research and innovation are powerful drivers of competitiveness, productivity, and economic diversification; but also, critical contributors to solutions for key developmental challenges such as climate change, inclusive growth, and public health.** Globally, innovative companies have been shown to grow 15 percent faster in sales and 8 percent faster in labor productivity than firms that do not innovate.¹⁹ Firm R&D expenditures significantly contribute to sales (by 14 percent) and labor productivity growth (by 7 percent). Scientific and technological innovation can also help address social challenges, such as health and demographic challenges, social exclusion, poverty, and inequality. A country's capability to produce, use, and commercialize scientific research is critical for developing innovative solutions to key environmental and socio-economic challenges. Research capacity is also needed for strategically acquiring and adapting innovations from abroad.
8. **Innovation is also increasingly perceived as integral for tackling climate and environmental challenges to promote low carbon and climate resilient growth.** Peru has seven of the nine characteristics recognized by the United Nations Framework Convention on Climate Change (UNFCCC) to describe a country as "particularly vulnerable" to climate change: low-lying coastal area, arid and semi-arid lands, areas liable to flood, drought and desertification, fragile mountain ecosystems, disaster-prone areas, areas with high urban atmospheric pollution, and economies highly dependent on income generated from the production and use of fossil fuels.²⁰ The effects of climate change on most of these characteristics pose particular challenges for food security and biodiversity in Peru. Agricultural production in the highlands and along the coast is sensitive to changes in temperature and precipitation, so the increased variability of weather and intensity of adverse weather patterns (e.g., extreme temperatures, distribution of precipitation) is projected to result in continuing heavy crop losses.²¹ Deglaciation is leading to water scarcity in coastal areas and has already led to species migration, such as the native potato and other crops now being produced in increasingly higher altitudes and exposed to shorter growing seasons and more snowstorms, floods, and droughts. Increased temperatures have also introduced pests, such as the Andean potato weevil, and overall shifts in pest and disease distribution.²² Peru is also one of the most biodiverse countries in the world, with rich marine coastal, Andean highlands, and Amazonian ecosystems, but this diversity is at risk due to changes in temperature and variability in precipitation that are forcing ecosystems to migrate to

¹⁷ Sea level is expected to rise 0.5 meters by 2100 posing additional threats to coastal urban populations. World Bank, Climate Change Knowledge Portal.

¹⁸ <https://www.cepal.org/en/comunicados/pesca-ganaderia-altoandina-y-agricultura-serian-los-sectores-mas-afectados-por-el-cambio>

¹⁹ World Bank 2009; Seker 2012

²⁰ UNFCCC NDC Registry. 2015. Intended Nationally Determined Contribution from the Republic of Peru.

²¹ World Bank; CIAT; CATIE. 2015. Climate-Smart Agriculture in Peru. CSA Country Profiles for Latin America Series. 2nd. ed. Washington D.C.: The World Bank Group.

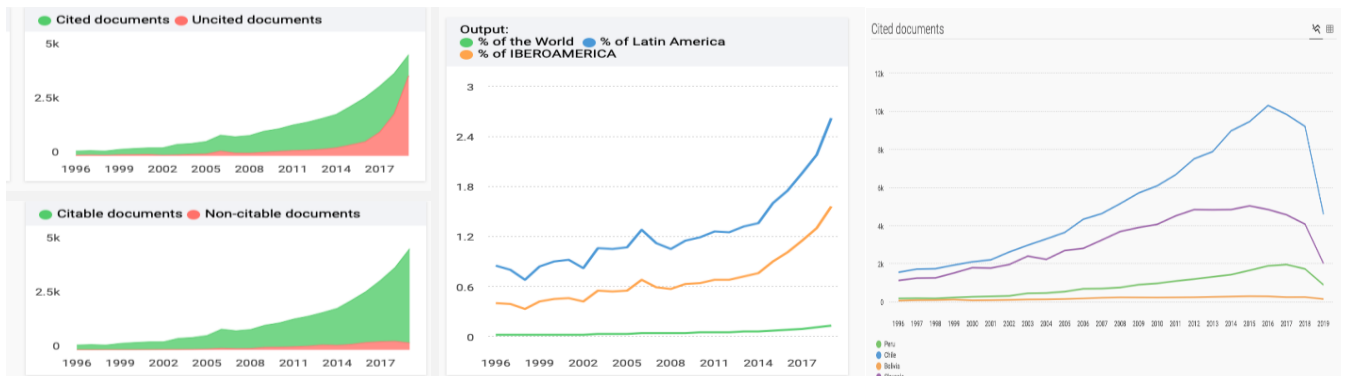
²² USAID. 2017. Climate Change Risk Profile: Peru.



higher elevations, threatening endemic species and increasing incidence of disease or extinction. Fluctuations in currents and sea surface temperature are also changing fish population and distribution.²³ The introduction of new technologies and production processes can facilitate climate change mitigation and the reduction of greenhouse gas (GHG) emissions, while climate-smart technologies and non-technological innovations, such as environmental management practices in agriculture and manufacturing, can facilitate adaptation to climate change, reduce vulnerability and exposure to current climate variability, and conserve biodiversity. In order to identify effective approaches to climate mitigation and adaptation in Peru and within specific sectors, research, design, knowledge, and innovation are required.

- 9. **In the case of Peru, innovation market pull and push factors are inefficient and limit the ability of the National Innovation System (SINACTI²⁴) to contribute to solving development challenges.** Innovation demand (by private sector firms and society at large) and the supply of knowledge and R&D are both limited and misaligned. As far as innovation push dynamics are concerned²⁵ Peru does produce *some* quality R&D outputs in specific areas of excellence,²⁶ but it does not produce *enough* R&D to create a critical mass with enough positive externalities for the economy, and it fails to *transfer* the quality R&D it does produce into innovation.
- 10. **The quality of research in Peru is relatively high in specific areas of excellence, but the volume of research output is low.** Peru ranks 6th in the quality of science among 48 Latin American countries and 58th globally (out of 238 countries) based on the h-index that measures the productivity and citation impact of scientific publications.²⁷ Peru ranks 74th globally in the number of citable documents and 70th in the number of citations, pointing at the low volume of output in R&D. Medical research makes up the biggest share (almost 40 percent) of total research output (Figure 1) and has the highest quality (52nd globally in h-index in medicine and 6th in Latin America), making it an area of science with a clear and strong potential for knowledge and technology transfer. Engineering and Agriculture are also important areas of quality research in Peru's universities and PRIs with potential for impact on the development of mining, fisheries, and food production.

Figure 1: International citation of Peru's scientific publications



Source: SCIMAGO

- 11. **Quite remarkably, even in the areas where Peru sustains investment and demonstrates high quality in academic R&D, outputs do not translate into an increase in innovation, revealing weak industry-academia**

²³ Ibid.

²⁴ SINACTI is the Spanish acronym for the Peruvian National Innovation System: Sistema Nacional de Ciencia, Tecnología e Innovación.

²⁵ The Government of Peru has asked the World Bank to primarily focus on the innovation 'push' factors, and the IDB to primarily focus on the innovation 'pull' factors, while acknowledging the need for close coordination and synergies between both.

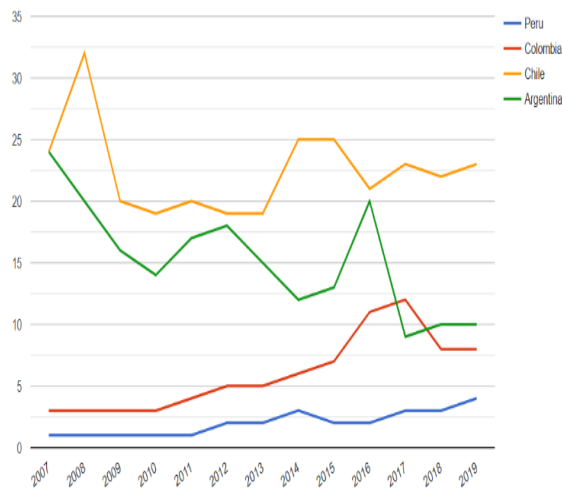
²⁶ Peru's h-index (in part based on number of citable scientific articles (quantity) the quality of scientific articles) in SCIMAGO – April 14, 2021 - is better than in both Chile and Colombia.

²⁷ Sources: SCIMAGO, April 14, 2021; Slovenia, Bolivia, and Chile.



linkages. Analysis of WIPO data for Peru from 2017-2019 indicates that that the number of industrial design applications and registration design counts, as well as the number of patent applications, has stayed relatively constant over the past decade in Peru. Peruvian inventors apply for much fewer patents than their regional peers both in relative and absolute terms. Figure 2 shows the number of patent applications per million population in Argentina, Chile, and Colombia. Leading and research-intensive universities also display an important gap between research activities and innovation output as measured by patents, suggesting a challenge among all institutions to transfer technology and knowledge. Figure 3 presents the research and global innovation rankings of the six leading universities in Peru over the past decade.²⁸ The figure shows that the innovation rankings are currently much lower than the research rankings for these top universities- and have declined precipitously over the past years (from a global rank of 367 in 2015 to 510 in 2021 for the Pontificia Universidad Católica del Peru).

Figure 2: Resident patent application per million population



Source: WIPO

Figure 3: University ranking (y-axis) in Research vs. Innovation of top 6 Peruvian universities.



12. **There are multiple deficiencies in Peru’s national innovation system (SINACTI²⁹) that explain this low performance.** Evidence points to i) low quality of higher education, especially at the higher end of the training chain (doctoral programs) and outside Lima, and a corresponding insufficient number of qualified researchers; ii) inadequate incentives and capacities for Industry-Academia collaboration and knowledge/technology transfer; iii) substantial deficits and poor allocation of public and private investments in R&D and innovation;³⁰ and iv) fragmented governance and ineffective science, technology and innovation policies.

13. **Insufficient numbers of qualified researchers in academia directly contribute to very low quantities of quality research output.** According to the National Register of Science and Technology (RENACYT), in February 2021, there were 5,942 full-time researchers across all disciplines in Peru, representing a rate of 0.3 researchers per thousand members of the working economic population, which is well below the Latin American and Caribbean

²⁸ The research ranking refers to the volume, impact, and quality of the institution's research output. The innovation ranking is calculated on the number of patent applications of the institution and the citations that its research output receives from patents. The ranking includes 3,897 institutions.

²⁹ Abbreviation from Spanish *Sistema Nacional de Ciencia Tecnología e Innovación*

³⁰ Including technology uptake more broadly



(1.3) or the OECD (12.7) average.³¹ Less than half of the researchers are in Science, Technology, and Innovation (STI) disciplines which are the drivers of innovation. According to World Bank estimates, by 2021 Peru should have had 17,500 researchers with doctorates in the areas of basic sciences and engineering to keep pace with countries that have level of GDP per capita between US\$8,000 and US\$10,000.³² Considering the number of researchers with doctorates in STI areas registered in CONCYTEC does not exceed 2,000, the required level is between eight and nine times more than the current level. Generating a future stream of doctoral degree holders is not only a question of the establishment of doctoral programs and inviting candidates to apply. As doctoral candidates are typically skilled individuals of working age, the opportunity cost of enrolling in a doctoral program is high. Doctoral researchers provide research and teaching services of value to the university, even as they undergo training related to obtaining their degree. Consequently, doctoral programs typically need to provide a stipend or scholarship as compensation. The scholarship requirement provides a further fiscal constraint on the creation of new programs or expansion of new programs.

14. **Further, even with the small number of researchers, there is an additional problem of gender and regional disparity in the number of researchers in Peru.** The 31 percent share of female researchers in Peru of the total is the lowest in Latin America, pointing to an important gender inequality in the research community.³³ Researchers are also heavily concentrated in Lima (60 percent), followed by Arequipa with only 5.7 percent. According to information from the National Higher Education University Superintendency (SUNEDU), Peru has 406 Doctoral Programs,³⁴ of which 40 percent are in Lima, and the rest in other regions, mostly concentrated in Arequipa, Ancash, and La Libertad, while in Ica and Moquegua there is no doctoral program. Even though a concentration of research in the capital city is seen in all countries, there is a particular disconnect in Peru between research capabilities in the regions and the country's development plans regarding regional equity. Connecting research with regional economic activities (extractive industries, agriculture including marine fisheries, tourism) and the country's climate agenda forms part of the context for the current project.
15. **The low number of researchers and the low quality and impact of R&D outputs is partly driven by the deficit in number of world class quality PhD programs in Peru, and the very low ratio of university faculty and research staff with PhDs.** SUNEDU reports that only 18.2 percent of the faculty in licensed universities have a Ph.D. degree³⁵. Even though there are more than 400 doctoral programs in Peru and the number of graduates greatly exceed those of neighboring countries (803 in Colombia, 807 in Chile and 2047 in Peru in 2018),³⁶ a recent study of the University Superintendency (SUNEDU)³⁷ reflects that only 41 percent of the PhD programs in Peru are offered by high-performing research universities and only 39 doctoral programs (less than 10 percent of the total) have completed the accreditation process of the National System of Evaluation, Accreditation and Certification of Educational Quality (SINEACE). In addition, only 20 percent of PhD programs are in STEM areas and 13 percent in health. Furthermore, of the approximately 12,300 doctoral students registered in 2020, 9,800 were enrolled in the areas of education, law, administration, and social sciences.

³¹ <https://portal.concytec.gob.pe/georencact/>. CONCYTEC. I National Research and Development Census to Research Centers 2016. Lima, 2016.

³² A country that seeks to maintain a level of GDP per capita between US\$ 8,000 and US\$ 10,000 should maintain on average 1,600 researchers per million inhabitants. This value is obtained using an average of the figures of researchers from Chile, Hungary, Mexico, Poland, and Turkey. It should be noted that the average of the five countries is taken for a long-term reference. Estimates indicate that Peru will require about 7,000 PhD graduates in the specialty of engineering and technology, 4,000 graduates in the specialty of natural sciences, 3,000 graduates in the specialty of medical sciences and health, and approximately 2,000 graduates in the specialty of agricultural sciences. The current distribution of doctoral programs is not aligned with this: Medicine (including Nursing) with 17.8 percent of programs, Education (11.5 percent), Business Administration (10.8 percent), Environmental Science (9.4 percent), Law (6.6 percent), Engineering (5.8 percent), Economics (5.0), ICT (4.2), Exact sciences (incl Physics and Chemistry) (3.7), Natural Sciences (incl. Biology) (2.9)

³³ UNESCO Institute for Statistics. 2019. Women in Science. Fact Sheet No. 55.

³⁴ <https://portal.concytec.gob.pe/georencact/>

³⁵ SUNEDU Informe Bienal 2020: <https://cdn.www.gob.pe/uploads/document/file/1230044/Informe%20Bial.pdf>

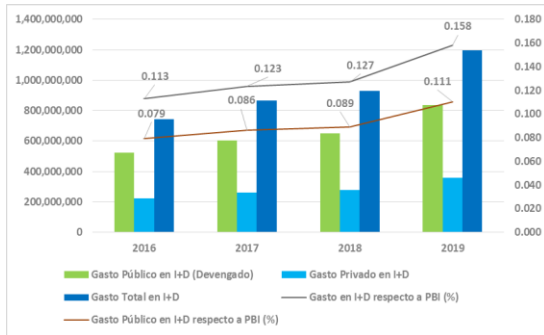
³⁶ OECD statistics for Colombia and Chile and SUNEDU (<https://enlinea.sunedu.gob.pe/>)

³⁷ La formación doctoral en el Perú, Oferta, admisión y matrícula en universidades licenciadas, Manuel Etesse, SUNEDU, 2021



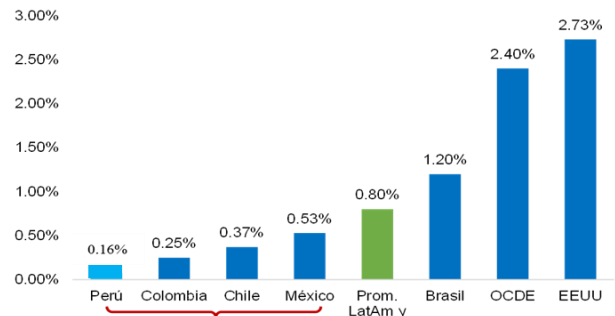
16. **Intellectual property and technology transfer policies and capacities are also suboptimal and very uneven among different institutions, stifling the identification and support to knowledge with commercial potential, and creating misaligned incentives for researchers.** A survey of 78 universities³⁸ revealed that only eight universities have more than five dedicated people in their technology transfer offices. Technology transfer policies in the 16 Public Research Institutes (PRI) in Peru are also highly diverse with seven PRIs having no technology transfer policies at all, four having policies that are only partially implemented, and only five institutes with fully implemented technology transfer policies. Other key barriers to technology transfer include insufficient human capital specialized in technology transfer, restrictive legal and regulatory frameworks for commercialization and technology transfer in different sectors, insufficient or weak technology transfer offices, lack of financial and non-financial incentives, lack of knowledge of relevance of research in innovation, among others.³⁹ A 2016 report found that only a limited number of researchers and engineers dedicate a substantial part of their work to R&D and innovation activities, partly driven by strict employment regulations at universities and research centers.⁴⁰
17. **Low R&D outputs are also explained by low public investment in basic and applied research in Peru.**⁴¹ In 2019, Peru invested 0.16 percent of GDP in R&D, which is an increase from 0.11 percent in 2016 (Figure 4), but still about half of the average for the Pacific Alliance (Figure 5), and well below the OECD average of 2.4 percent.⁴² Post-COVID fiscal constraints are already affecting public investments in STI, which had increased from \$171 million in 2011 to \$229 million in 2019 only to fall back to \$195 million in 2020. To preserve past gains and unleash further innovative potential, Peru needs to substantially increase long-term investment in strategic areas of research and, in parallel, increase the impact of investments through improved linkages with the private sector and applied use of knowledge and research. This should include funding for R&D outputs with potential commercial application, which is currently unavailable to researchers, except for an embryonic pilot under the ongoing World Bank Group (WBG) financed project Strengthening the Science, Technology, and Innovation System in Peru (STIS; P156250).

Figure 4: Composition of R&D research in Peru



Source: MEF – SIAF, INEI. Preparation: CONCYTEC-DIE

Figure 5: R&D Spending as % of GDP



Source: RICYT 2017. Peru 2019. Preparation: CONCYTEC-DIE

18. **There are also systemic barriers on the part of the private sector that limit private sector investment in R&D and constrain industry collaboration with academia.** Like other Latin American countries, over two thirds of investment in R&D in Peru were made by the public sector (Figure 4). Almost all R&D investment in Peru is in

³⁸ CONCYTEC. How are the offices in TT and IP in Peru today? 2020.

³⁹ Technopolis. "Unblocking and knowledge commercialization in Peru." 2016.

⁴⁰ Ibid.

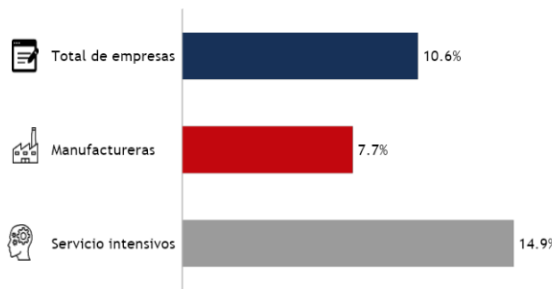
⁴¹ Although it has been slowly and steadily rising over the past years, with some visible effect in the above-mentioned areas of excellence.

⁴² RICYT 2017.



basic and applied science, and only 7.3 percent is in technological development,⁴³ which indicates market failures constraining private sector investment, such as low appropriability or concentrated market power in some sectors that limits innovation-driven competition. Most importantly, weak governance and public-private dialogue led to low relevance of much of the produced research to market demand, as well as a lack of alignment with the country's priority developmental challenges.⁴⁴ Low relevance of research in turn leads to low interest by industries to collaborate with academia, resulting in a self-perpetuating cycle. A stakeholder network mapping of the innovative entrepreneurship ecosystem in Lima⁴⁵ found that most of the relationships between actors reflect sporadic contacts (39.9 percent) with low level of joint work (16.7 percent). Only 10.6 percent of companies that carry out innovation activities do so by linking with an institution or agent of the STI ecosystem, highlighting the weak link between the productive sector and research institutions (Figure 6).⁴⁶ The innovation activities that companies do carry out are based on the incorporation of packaged (ready to use) technology, or the acquisition of capital goods. Only 5.3 percent of companies that carry out innovation activities do so through external R&D, which demonstrates a low level of technology transfer between academia and industry (Figure 7).

Figure 6: Percentage of companies that linked with an institution or external agent to develop innovation (2015-2017)



Source: National Survey of Innovation in the Manufacturing Industry 2018.

Figure 7: Companies that conducted innovation activities 2015-2017



Source: National Survey of Innovation in the Manufacturing Industry 2018.

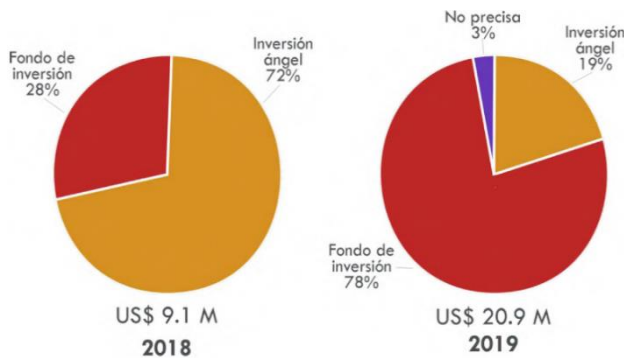
19. **Limited funding for science-based business innovation and startups is another critical barrier to the commercialization of R&D in Peru.** Only 10 percent of startups survive more than five years, and financing is cited as the second most frequent cause of failure.⁴⁷ The market for risk finance is still very small but growing: between 2016 and 2018, only \$21.8 million was invested in 54 startups, while in 2019 alone, the total number of investment in startups was \$20.9 million (Figure 8).⁴⁸ Venture capital funds became the biggest source of

⁴³ The share of R&D spent on technological development in OECD countries averages around 60 percent, driven by private investment.
⁴⁴ A 2020 study by CONCYTEC shows that of the notional 384 PhD programs in Peru, 11.5 percent were on topics in Education, while only 5.4 percent were on engineering and 4.1 percent on ICT with even fewer on other STI topics.
⁴⁵ IDB. "How to map and measure entrepreneurship ecosystems? Methodology and application for the innovative entrepreneurship ecosystem in Lima." 2020.
⁴⁶ National Survey of Innovation in the Manufacturing Industry 2018.
⁴⁷ Ministerio de Producción. Encuesta Nacional de Innovación en Industria Manufacturera y Servicios Intensivos en Conocimiento. 2018.
⁴⁸ PECAP. "Report on Entrepreneurial Capital in Peru: 2016-2018."



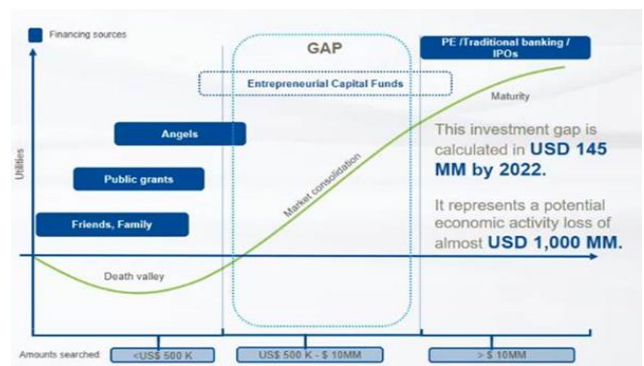
investment in startups in 2019 representing 78 percent of all investments (Figure 8)⁴⁹, driven by a large growth in international investment which accounts for over two thirds of the market. The investment gap, however, remains huge. By 2022, the gap is estimated to grow to \$145 million (Figure 9), pointing to risk aversion on the part of private investors to fund market readiness of innovation, which in turn contributes to a weak pipeline of investment-ready scientific innovation that cannot attract funds at scale. This points to a critical role for the public sector in de-risking private investment and enlarging the pipeline at the inception phase of the innovation lifecycle, particularly for disruptive technologies and university spinoffs.

Figure 8: Investments in startups by type of investments



Source: COFIDE, PwC 2017

Figure 9: Investments in startups by type of investment



Source: COFIDE, PwC 2017

20. **Finally, institutional implementation capacity is low, starting with the governing body of the Science, Technology, and Innovation (STI) system, CONCYTEC.** Three main constraints continue to prevent it from effectively fulfilling its role: i) despite being hosted in the Prime Minister’s Office, CONCYTEC does not yet benefit from sufficient recognition of its transversal mandate; ii) insufficiently developed and uncoordinated digital management and accounting systems do not allow CONCYTEC to have an accurate and timely overview of public expenditures on R&D and Innovation across the various agencies and public institutions of the overall SINACTI; and iii) the financial and institutional arrangements in Peru currently prevent CONCYTEC from directing its own funds to partner research and innovation support institutions and programs in line ministries. This has resulted in a deficit of strategic vision, coordination, and implementation capacity.

21. **The institutional context is also fragmented with instruments and policies that require updating and strengthening to effectively support STI growth.** Recent analysis⁵⁰ of SINACTI instruments in Peru found that they cover 11 sectors or government entities, with several agencies and entities within each sector, and a large concentration of expenditures on a small number of instruments. The analysis found a lot of overlap between the sectors, with overlapping beneficiaries and interventions mechanisms, while private sector-focused instruments showed little specialization in business types and needs and little emphasis on improving productivity and diversification. A Public Expenditure Review⁵¹ was launched in 2018 as part of the ongoing World Bank Innovation project. The first phase of the analysis of the policy mix found that strategic priorities identified in SINACTI plans and programs were not matched with commensurate levels of funding, and that actual

⁴⁹ PECAP. Entrepreneurship Capital Report. 2019.

⁵⁰ World Bank. Estrategias de Innovación para el Perú. 2020.

⁵¹ The PER is being conducted under the ongoing Peru Innovation project (Strengthening the Science, Technology, and Innovation System in Peru), and only phase 1 so far has been completed, with phase 2 currently under implementation.



investments in support of technology and knowledge transfer were lower in areas that were declared priorities.

22. **To address these challenges, the Government of Peru has launched three World Bank-financed investment projects in recent years:** the Strengthening the Science, Technology, and Innovation System in Peru project (STIS, P156250), the National Agricultural Innovation Project (PNIA, P131013), and the National Program for Innovation in Fisheries and Aquaculture (PNIPA, P155902). Together, these projects have achieved incipient improvements in the innovation ecosystem in Peru that the proposed Series of Projects (SOP) aims to capitalize on and consolidate. The scope and nature of the challenges facing the SINACTI are also becoming clearer thanks to the depth and intensity of recent engagements. The STIS, particularly, provided a blueprint to the proposed first project under the SOP, by piloting instruments that tackle some of the key challenges mentioned above. For example, the Public Expenditure Review conducted under the STIS operation was the first of its kind in Peru and provided a concrete and comprehensive overview of the redundancies and overlaps in the STI system, which not only directly informed the recent reforms of the SINACTI Law that were approved in July, but also informed the design of the grants and institutional reinforcement activities foreseen under this new project. Another example is the introduction of value chain and sector-focused public-private dialogues to identify the technology and R&D needs of the private sector and communicate the identified needs to universities and PRIs. The proposed SOP will also provide needed continuity. The experience in STIS echoes the one described in the Implementation Completion and Results Report for PNIA, which notes that while the project achieved progress in strengthening the institutional capacity to support innovation in agriculture, the gains could be threatened if the Government does not follow through with policy reforms and supporting investments.⁵²
23. **In parallel, support to this agenda has also been provided by the IDB, with a focus on technology adoption by private sector firms,** primarily through the National Innovation Program for Competitiveness and Productivity (Innovate Peru) and financed by the Fund for Innovation, Science and Technology (FINCYT).⁵³ Since 2012, and through the new IDB project currently under preparation, FINCYT provides matching grants to firms to incentivize private investment in technology adoption and the development of innovative products and services. The IDB project has funded emerging enterprises and service providers of technology outreach activities, as well as research projects and scholarships for postgraduate studies in Peru and abroad to promote research, development, and innovation skills. Furthermore, to stimulate innovation development Innovate Peru provides funding and competitions for startups, helps them secure grant funding and facilitates cooperation with other stakeholders in the SINACTI, many of which are also partners and beneficiaries of Innovate and recipients of current or planned IDB funding.

C. Relevance to Higher Level Objectives

24. **The proposed project directly contributes to the World Bank Group's Country Partnership Framework (CPF) for Peru for the period FY17 to FY21⁵⁴.** The project is closely linked to multiple Objectives under Pillar I: "Productivity for Growth" and is aligned with Pillar III: "Natural Resource and Climate Change Risk Management". With respect to Pillar I Objective 2: "Facilitate absorption of skills and technology," Component 2 of the project promotes a stronger prioritization of investments in doctoral programs and skills in alignment with the needs of the private sector. Component 3 includes activities that improve industry-academia linkages and alignments between investment in R&D and the specific needs of the private sector in terms of technology and innovation, thus increasing the absorption rate by firms of technological advances discovered via these R&D investments. In addition, the project contributes to Pillar I Objective 3: "Enhance the environment for sustainable private

⁵² Implementation Completion and Results Report. 2021. *National Agricultural Innovation System (P131013)*.

⁵³ Acronym of the IDB financed project on science and technology. The ongoing project is the third FINCYT operation (FINCYT 3).

⁵⁴ WBG Country Partnership Framework for the Republic of Peru for the Period FY17-FY21. Report No. 112299-PE, April 2017.



investments” through activities under Components 1 and 3 that seek to improve the governance of the innovation system and improve innovation resources and financing thus enhancing productivity and investment. In line with Pillar III of the CPF, grants and scholarships in Components 2 and 3 have a major focus—an estimated 50 percent of expenditures—on climate change adaptation and mitigation-related themes. Finally, the Project aims to contribute to gender equality, which is a cross-cutting objective of the CPF, by increasing the participation of women in Peru’s STI system. To this end, the operation will provide incentives to female researchers encouraging and increasing their participation in the SINACTI. The participation of women in the competitive grants and the doctoral scholarship programs will be promoted and tracked as part of the project.

25. **The project also contributes to several of Peru’s key legislative reforms, policy and multi-year implementation plans to invest in Science, Technology, and Innovation.** The project is particularly well aligned with: (i) Objective 2 “Promoting scientific and technological research aimed at solving problems and satisfying demands in the strategic priority areas” of The National Strategic Plan of Science, Technology and Innovation for Competitiveness and Human Development PNCTI 2006-2021 (Law No. 28303); (ii) Objective 1 – “Promote the generation and transfer of scientific-technological knowledge, aligning the research results with the needs of the country”, Objective 3 – “Promote the generation of duly qualified human capital for STI” – and Objective 4 “Improve the quality levels of research and technological development centers” of the National Policy for the Development of Science, Technology and Technological Innovation (NPDSTI), approved in 2016 (Supreme Decree No. 015-2016), which establishes the guidelines aimed at strengthening and improving the performance of science, technology, and technological innovation in the country; and (iii) Objective 3 of the National Competitiveness and Productivity Plan (PNCP), enacted in 2019 with a 2030 implementation horizon, which aims to i) strengthen the institutional framework of the SINACTI in Peru, ii) promote the training of highly specialized human capital (researchers, technicians and managers in STI) to help overcome the current scarcity of scientific production and insufficient technological development in the country, and iii) promote private sector investment in STI.

II. PROJECT DESCRIPTION

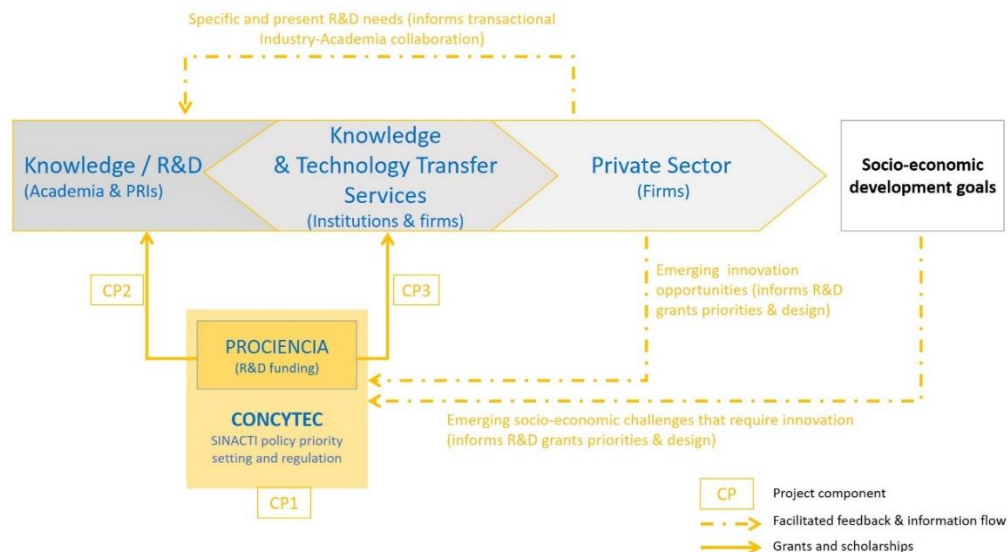
26. **Building on the ongoing STIS operation, this new project is the first in a Series of Projects (SOPs) with the overarching objective of improving the contribution of Peru’s National Innovation System (SINACTI) to the economy’s productivity and diversification, with a special focus on green growth and regional development.** The total expected cost of the series is US\$300 million. The Government of Peru’s request for this operation is matched by a similar request to the IDB for a 15-year US\$300 million set of projects to finance technology adoption and other demand-side investments in the innovation system.
27. **The SOP approach signals the long-term policy commitment of the Government of Peru and the World Bank to a programmatic set of investments and implementation support that are crucial for achieving meaningful impact.** Sustained support is contingent on overall implementation progress and achievement of results and incentivizes the Government to remain focused on the SINACTI. Research from OECD countries shows that continuous long-term support and policy consistency are critical for National Innovation Systems and institutions to develop and investments in R&D to materialize. By allowing time to demonstrate results, a long-term framework can strengthen the alignment and buy-in from all stakeholders of the SINACTI, including the private sector. The SOP also allows a realistic initial scope of activities, that can gradually be scaled up to reduce the risk of failure from low implementation capacity of large and complex operations. The current absorptive capacity of the academic ecosystem and specialized research programs remains moderate, so support for quality PhD and R&D programs will be implemented gradually and leverage consortia and consultations before being scaled up in subsequent phases. A series of projects would also allow for flexibility to tailor and adapt subsequent phases



based on lessons learned from earlier investments. Impact could be measured more robustly by incorporating a Randomized Control Trial (RCT) approach whenever feasible and facilitating evidence-based learning.

- 28. **Each Project in the series will be structured along three complementary components:** i) Institutions, governance, and infrastructure for Innovation; ii) Capacity development for knowledge generation in strategic sectors and regions; and iii) Industry-academia linkages to accelerate technology transfers and science-based business innovation in strategic sectors. Figure 10 shows how each component supports the critical and interdependent elements of the SINACTI ecosystem. The proposed SOP will prioritize support to governance, knowledge generation, and knowledge and technology transfers between academia/public research institutes and the private sector. Future projects in the series, in close coordination with projects by the IDB, could also prioritize direct support to private sector startups and private investment in innovation. The complementarities and synergies between the two development partners will ensure that all identified challenges are addressed and there are no gaps in the critical path to success. The increased focus on the knowledge and technology transfer segment in this project (e.g., industry-academia) reflects the lessons learned from current engagements regarding the critical catalyst role it can play in boosting innovation.

Figure 10: Activities and components of the SINACTI supported by the project (SOP-1)



- 29. **The first project in the SOP is the subject of this PAD, and will include activities in all three components, but with a focus on a subset of beneficiaries: universities and public research institutes most ready to engage in the proposed activities.** The first project supports CONCYTEC in implementing the recently approved institutional and governance reforms, thereby increasing its capacity—and the capacity of the SINACTI as a whole—to scale up the implementation of innovation programs in subsequent projects. This project will also allow teams to test and strengthen the “Alliance” approach⁵⁵ in PhD programs, and evaluate demand and absorptive capacity of public universities in the targeted regions with higher accuracy, before designing the subsequent projects where such “Alliances” could be rolled out at a larger scale. This phased approach - suited to the context of Peru where the large need gap regarding knowledge generation requires long term engagement - focuses on i) setting standards affecting all PhD programs, and supporting universities to adhere to these quality standards while concentrating on selected strategic STI areas; ii) supporting investments in essential equipment in nodal

⁵⁵ See description of the approach under section B, project descriptions, Component 2.1



laboratories for high quality research in STI areas, while promoting equipment-sharing and collaboration across institutions; and iii) promoting research excellence by linking national and international universities. Network growth effects are paramount for the best value from money of initial investments in knowledge generation. Finally, the first project will closely monitor the implementation of value chain specific Industry-Academia public-private dialogues, and the pipeline and market size for science-based innovation products, and the information obtained through this monitoring will help inform more accurately the design of academic entrepreneurship grants and equity investments in the subsequent projects. The first project will be this proposed five-year IPF in the amount of US\$125M.

30. **The first project will focus investments on knowledge generation and capacity building in STI institutes (Component 2) and industry-academia linkages (Component 3) in three “Strategic Areas”: a) low carbon and climate-resilient economy; b) health; and c) digital economy and ICT.** Using the SINACTI to contribute to climate change mitigation and adaptation and a green economy is an important—and increasingly urgent—objective of the government and research community and will be directly supported by this project. Peru’s vulnerability to climate change impacts (described above) requires adaptation measures, and Peru’s own ambitious Paris Agreement commitment to reduce GHG emissions requires mitigation measures. Hence, 50 percent of the Component 2 and 3 funds will be earmarked for the low carbon and climate-resilient economy Strategic Area. The strategic investment in Health builds on the opportunity of a strong existing medical research capacity and academic quality (as noted in the previous section), while also aiming to address structural shortcomings in the health sector, further exposed by COVID-19 and other endemic diseases in Peru. The digital economy and ICT area was selected due to the transversal, enabling nature of digital technologies for all sectors of the economy (which have been made even more clear by the pandemic). The health and digital Strategic Areas are expected to absorb about 30 percent of Component 2 and 3 funds, with the remaining 20 percent of funds available for all other scientific research areas. The Strategic Areas can be described as follows:

(a) Low carbon and climate-resilient economy (a.k.a. Climate Strategic Area), including a) R&D and innovation on how to adapt the Peruvian economy and territory to climate-induced changes to increase its resilience; and b) research on or development of renewable energy, energy efficiency improvement, low-carbon technologies, or other technologies instrumental to achieving full decarbonization. Sub-themes identified by the government include:

- i. *Renewable energy*, promoting the use of clean energy technologies to reduce GHG emissions by growing existing capacity in hydroelectric power generation (which accounted for 59 percent of total electricity generation in 2020 in Peru), and catalyzing potential in wind, biomass, solar, and other renewables (which accounted for only 6 percent of generation in 2020).⁵⁶ The strategic promotion of the bioeconomy in Peru, currently being analyzed, may add new opportunities for renewable energy production through residual biomass.
- ii. *Circular economy*, with the aim of reducing energy and/or material use across a supply chain to ultimately reduce GHG emissions. This will be promoted through the minimization of waste and the use of recycled inputs in production processes, enhancing the reuse and recirculation of materials, improving industrial waste management, and rethinking products’ entire value chains to address climate and environmental issues of production and consumption. This is in line with the Peruvian government’s Circular Economy Roadmap for the Industrial Sector developed in 2020, which establishes periodic regulatory goals, including cleaner production agreements, technical standards for packaging, non-financial incentive mechanisms, guides for adequate waste management in the manufacturing and industrial fishing sectors, and the formalization

⁵⁶ Electricity generation data comes from <https://ourworldindata.org/energy/country/peru>



- and certification of recyclers' skills. This year, the Roadmap exercise has expanded to the agriculture and fishing sectors, supporting existing programs and investments in the coffee, dairy, and fruit supply chains, among others.
- iii. *Food security*, particularly related to the adaptation of agricultural production to climate-induced changes and the reduction of emissions from agriculture through climate smart agricultural practices, such as integrated and efficient water management, pressurized irrigation systems, more efficient fertilizer use, soil conservation, crop diversification, and development of drought-resistant and water-efficient crops and varieties, or agroforestry (the intentional integration of trees and shrubs into crops and animal farming systems to create carbon sequestration and adaptation benefits). These approaches are intended to primarily support climate mitigation and adaptation, while also improving ecosystem services, conserving biodiversity, and improving livelihood outcomes for producers.
 - iv. *Sustainable use of biodiversity*, specifically through the conservation and sustainable management of natural resources to mitigate and adapt to climate change impacts. This would be accomplished through approaches that limit habitat loss and maximize the country's diverse ecosystems' resilience to climate impacts⁵⁷, as well as those that mitigate climate change through sustainable land use and habitat conservation to reduce emissions.⁵⁸
 - v. *Other climate change mitigation and adaptation*. Any other climate-related R&D and innovation not covered by the above areas that support a reduction in GHG emissions or promote resilience to climate change impacts such as floods, landslides, etc. Examples that are important in the Peruvian context include innovations in energy and resource efficiency in agriculture and industry, developing alternative or recycled water supplies to improve resilience during droughts, decarbonization in the transport and power sectors, sustainable water management and adaptation of infrastructure networks to droughts, floods, and heatwaves, ecosystem restoration, innovative solutions for prevention of climate and natural disasters, etc.
- (b) **Health**. Further advances in health, medical, and epidemiological research can substantially contribute to Peru's improved resilience and response capacity to global health threats. This includes not only strengthening knowledge and R&D related to drugs, vaccines, or treatments, related to COVID-19 health responses, but also to neglected and endemic diseases of the country and the region (malaria, dengue, bartonellosis, trypanosomiasis, others). Climate change is also expected to have a negative impact on the health sector, with increased prevalence of vector-borne diseases. Locally generated health and medical research and innovation will thus be key in addressing challenges that are specific to the country. Innovative technologies, such as AI, robotics, or big data, and digitalization of health processes and services, such as telehealth or digital records, could also enhance the access to and quality of healthcare in Peru and improve health outcomes.
- (c) **Digital economy and ICT**. This includes knowledge, R&D, and innovation related to the digitization of the economy. Funding should help the economy adapt to accelerating global digital transformation trends catalyzed by the pandemic, as well as position the country's firms, human resources, and educational systems for the digital economy of the future. Digital tools promote efficiency and access to better services, such as education, government management, and foreign trade. Innovation can be a key driver in the adoption of digital technologies in both the public administration and the business sector.

⁵⁷ Conservation and restoration of natural resources will improve their ecosystem services, including water provisioning, production value (timber, non-timber forest products, food, medicine, etc.), biodiversity, temperature regulation, etc. which will support resilience in the face of extreme precipitation and temperature fluctuations expected to be exacerbated by climate change in Peru.

⁵⁸ It should be noted that land conversion for crop production is the largest source of GHG emissions in Peru.



31. **The subsequent two projects will adapt or scale activities based on the lessons learned from the previous project in the series.** The results framework (targets for PDO indicators and selection of intermediate indicators) will adapt to the limitations and opportunities of each subsequent project. Progress on indicators at the mid-term review of a project (3 years after effectiveness), or its final Implementation Completion and Results Report, will inform the timing, design and scale of the subsequent project. In addition to the scale-up of some of the activities that were tested in the first project (such as improvements to governance, the PhD programs, or research grants in Strategic Areas), the subsequent projects could eventually provide equity financing. Venture capital funding is critical to support startups from market consolidation to maturity. The MEF and COFIDE have recently established *Capital Emprendedor* (CE), a fund of funds to help fill Peru's missing link at the formal venture capital stage of follow-on investment. The Fund's investment strategy is to leverage private venture capital experience and expertise and encourage foreign and local funds to invest more in Peru's startups. CE integrated best practices from similar global experiences (including WB projects in other countries), but currently only contains US\$20M of seed funding provided by MEF (for a demand estimated by COFIDE to be closer to US\$145M). COFIDE is seeking to close the funding gap through co-investments by multilateral institutions like the WB and the IDB. The SOP could eventually contribute to CE to help attract private sector venture capital investment in early-stage financing of science-based spinoffs in Peru. As such, it would leverage local and foreign private sector capital to finance innovation in Peru, and is expected to use a matching approach to incentivize the participation of the private sector in financing seed or growth stage research and science-based spinoffs. The first project will allow teams and counterparts to monitor market demand and the performance of CE, thereby accurately informing the design and scale of the Series of Project's potential future contribution to the fund.

A. Project Development Objective

PDO Statement

32. The objective of the Project is to improve science, technology, and innovation services in targeted Strategic Areas and regions.⁵⁹

PDO Level Indicators

33. The project will measure the PDO with the following indicators:
- Number of public STI Institutions with adequate operational capacity.⁶⁰
 - Number of PhD graduate students receiving project-funded scholarships at supported doctoral programs.⁶¹
 - Number of new or updated technologies developed by consortia targeting value chains and innovative firms.⁶²

B. Project Components

34. **The proposed Project will strengthen Peru's SINACTI through an integrated approach across three**

⁵⁹ STI services refer to services provided by universities, public research institutes, CITES, and other SINACTI institutions to promote STI. In the government's pre-feasibility study for the project (approved in *Invierte.pe*), the Strategic Areas (described in paragraph 30) are referred to as "sectors". The PAD uses the "Strategic Areas" terminology to avoid the confusion with a selection of economic "sectors" or industries. Targeted regions are those outside of the Metropolitan Area of Lima.

⁶⁰ Adequate operational capacity is defined in terms of STI outputs produced, e.g., publications, patents, and partnerships, or equivalent. Threshold values of outputs will be defined in the Project Operational Manual.

⁶¹ Supported doctoral programs will each include a partnership with a university in a region outside Lima, as described in Cpt 2.1.1.

⁶² The value chains refer primarily to those covered by the IVAs in Strategic Areas in Component 3.1.1. Technologies should be developed to a technological readiness level of 7 (TRL7).



complementary components that address the most critical gaps in the innovation ecosystem.⁶³ These include institutional strengthening (Component 1), knowledge generation (Component 2), and industry-academia linkages (Component 3). Financial instruments and grants used under the various components are interconnected; fig.11 on page 30 shows the complementarity between the key grants across all components.

35. **Component 1: Strengthening SINACTI's institutions and governance to bolster innovation in Peru** (US\$17M, of which 8 percent WB funds, 92 percent counterpart funds). This component will strengthen the governance of the SINACTI by improving the ability of its institutions to support the development of science, technology, and innovation capacities and enhance their contributions to sustainable development and climate change. Component 1 activities will enable the activities planned under components 2 and 3 by improving capacity to manage the R&D and innovation support instruments.
36. **Subcomponent 1.1. Supporting the reform of SINACTI's institutions and modernizing CONCYTEC's capacities, services, and policymaking mechanisms** (US\$12.9M). This subcomponent will finance goods, services, and capacity building consultancies to support the following areas:
 - a) **1.1.1 Strengthen CONCYTEC's institutional capacity to be the governing body of the SINACTI and lead innovation policymaking in Peru.** Examples of specific activities include support to CONCYTEC's and PROCENCIA's end-to-end digitalization and modernization of information and knowledge management systems and client services⁶⁴; the development of an integrated digital platform across innovation sectors⁶⁵; just-in-time analytical studies and position papers on key innovation policy reforms and topics (e.g. fiscal incentives for innovation, policies to promote innovation in the regions); and training and capacity building to improve management and monitoring and evaluation.
 - b) **1.1.2 Enhance the quality standards for STI-focused PhD programs in Peruvian universities.** The subcomponent will support the implementation of robust quality monitoring and evaluation systems for STI-focused PhD programs by financing consultancies to design a set of quality standards and indicators, internationally benchmark doctoral programs, develop a STI PhD accreditation work plan and proposal of regulatory arrangements. Benchmarking would include modernizing PhD programs to include integrated programs that start with students entering university, as done in some countries. This support will be implemented in coordination with the National System of Evaluation, Accreditation and Certification of Educational Quality (SINEACE) and National Higher Education University Superintendency (SUNEDU) in order to promote the adoption of these standards.
 - c) **1.1.3 Develop a national STI evaluation system to inform decision making on innovation policy and public expenditures.** Support CONCYTEC and the national statistics institute (*Instituto Nacional de Estadística e Informática*, INEI)⁶⁶ to develop robust indicators, rigorous surveys, and data services. Supported surveys will include the Census of R&D in Research Centers, National Survey of public perception of STI, National

⁶³ These do not overlap with the components of the SINACTI supported by the IDB project.

⁶⁴ Including the purchase of equipment. By enhancing the digitalization of the SINACTI's systems and services, this subcomponent aims to increase the SINACTI's resilience to adverse climate-related events that may result in data loss or disruption of services provision.

⁶⁵ Particularly, investments will increase the functionalities and deployment of the "PeruCRIS" platform- "Plataforma de gestion del conocimiento".

⁶⁶ Peru's national institute of statistics



Surveys of R&D and technology adoption in companies, Survey in STI activities, and Survey of scientific equipment in research centers.⁶⁷ Data collected through the national STI evaluation system will be fully integrated in the innovation policy-making process and serve as a direct input to investment decision-making. Furthermore, all of the data collected will be available to the public through government open data mechanisms and through the knowledge management platform (PeruCRIS), which was developed through the STIS project.

- d) **1.1.4 Evaluate the scope, performance, and institutional arrangements of leading PRIs in Peru.** The subcomponent will finance consultancies to define management standards and systems for PRIs and conduct self-diagnostics of PRIs jointly with international scientific institutions resulting in development of roadmaps for institutional improvement based on well-defined goals aimed to boost their contribution to innovation and technology transfer in strategic areas.
- e) **1.1.5 Support the formation and consolidation of specialized research networks in Strategic Areas.** The subcomponent will finance capacity building grants that will cover operational costs as well as training and other technical assistance activities to strengthen academic collaboration or joint output by consortia. Participants in the research networks will be able to apply for funding under other grant windows in the project, such as the research grants under sub-component 2.2.2, aimed at supporting the production of quality research.

37. **Subcomponent 1.2. Equal access to research in STI areas (US\$4.1M).** This subcomponent aims to contribute to reducing regional disparities in the SINACTI by ensuring equal and free access to scientific information and journals to all researchers across all regions in Peru, including students, teachers, and researchers from universities and PRIs. The subcomponent will finance the initial two-year subscription to full-text information resources and support consultancies to design a network operating model for contracting information resources that is financially sustainable beyond the first two years and guarantees universal access.

38. **Component 2: Capacity development for the generation of knowledge in Strategic Areas (US\$74.8M, of which 97 percent WB funds).** This component aims to improve the quality, quantity, and economic relevance of training at the doctoral and post-doctoral levels and promote the development of RDI projects in scientific areas primarily related to the Strategic Areas, with at least 50 percent earmarked for the Climate Strategic Area. The two sub-components are: i) Institutional partnerships for strengthening scientific research; and ii) Generation of knowledge in strategic areas. These activities aim to directly contribute to the development of R&D and innovative approaches that result in climate change mitigation and adaptation, health solutions, and the design of a digital economy.

39. **Subcomponent 2.1: Institutional alliances for strengthening research, science, and technology capacity (US\$38.7M).** This sub-component supports the development of high-quality doctoral programs in the three Strategic Areas which have been judged to be of economic relevance to Peru. To enhance the economic relevance of scientific research and to support the goal of equitable regional development, the subcomponent will be

⁶⁷ The census will be conducted by INEI and is planned to be financed with 100 percent counterpart resources. However, if the contracting of INEI with WB resources is needed, it can only be carried out in accordance with the Procurement Regulations applicable to the Project and recognizing only the incremental costs incurred by INEI. The other surveys will be contracted by PROCIENCIA.



implemented through cross-regional institutional alliances involving both public and private sector entities.

- a) **2.1.1 Support institutional alliances for strengthening doctoral programs in Strategic Areas (USD 17.8M).** The subcomponent will support up to eight institutional alliances (selected on a competitive basis), led by a public research university, that will be formed to support the creation or strengthening of doctoral programs of international quality in the Strategic Areas, including international research stays for students and faculty of the doctoral program and the development of research networks among the members of the alliance. As part of the overall commitment of earmarking 50 percent of funds under Component 2 to the climate strategic area, at least half of the alliances could support the creation or strengthening of doctoral programs and the development of research networks in the Climate Strategic Area of study. The alliances will consist of two or more Peruvian universities (with alliances including one outside the Metropolitan area of Lima being encouraged), one Public Research Institute (IPI), one well recognized international university, and private firms, business associations or a social organization, relevant to the program. The subcomponent will finance consultancies to create work plans, roadmaps, curriculum designs and other activities needed to obtain licenses by SUNEDU for supported doctoral programs. Approved doctoral programs will be supported with funding of expenses associated with promotion of the program, teaching, short- and long-term research stays, minor equipment and inputs needed to conduct research, and management of the alliance. Where feasible, integrated Masters' and Doctoral programs, can be created as part of the project. The subcomponent will also finance visiting researchers (both to and from Peru) and related travel to improve research capabilities of public and private universities associated with the doctoral program implemented by the alliance, as well as enrollment fees and tuition for Eligible Students who have received Scholarships under component 2.1.2 to study under such doctoral programs.
- b) **2.1.2 Finance scholarships for doctoral students at supported doctoral programs (US\$20.9M).** The subcomponent will support scholarships for Peruvian citizens to undergo doctoral training in the supported doctoral programs in the Strategic Areas. The scholarships will be assigned on a competitive basis considering merit and vulnerability of the candidates. Affirmative action will be taken to encourage the participation of female candidates⁶⁸ and underserved populations (indigenous peoples, afro-Peruanos, low socio-economic background, regions outside of Metropolitan Lima). As part of the overall commitment of earmarking 50 percent of funds under Component 2 to the climate strategic area, at least half of the scholarships could be awarded to students pursuing doctoral training in the Climate Strategic Area of study. The scholarships will finance maintenance expenses and support for social security contributions (health and pension) for a maximum of three years. Admission to the doctoral program is a prerequisite. The specific conditions of the scholarship will be established in the Scholarship Agreement. In support of ongoing efforts of project supported IPIs and universities to encourage participation in scientific investigation, outreach efforts to inspire youth to engage in scientific careers will be made to reach schools and colleges.

⁶⁸ Affirmative action means that if there are two or more candidates with the same level of merit, and one of them is a woman, she would be preferentially selected. It also means that dissemination efforts through communications and promotion visits by PROCENCIA to universities, including in regions, will be made to invite eligible candidates from the target groups to apply for the scholarships and grants. The results framework targets 40 percent of scholarships going to females. Given that the share of female researchers in Peru is 31 percent, this should help close the gender gap.



40. **Subcomponent 2.2: Support for knowledge generation in strategic areas (US\$36M).** This subcomponent will improve the capacity of universities and PRIs in Peru to generate knowledge and innovation in the identified Strategic Areas by strengthening laboratories and financing research grants. The subcomponent will finance eligible expenditures as mentioned under paragraph 44 to support the following areas:
- a) **2.2.1 Strengthen laboratories (US\$19.1M):** The subcomponent will finance the upgrade or acquisition of modern laboratory equipment for new and existing laboratories and fund the training of personnel to improve the capacity of research infrastructure of Peruvian institutions to carry out quality research in Strategic Areas. Funds for recipient laboratories will be awarded on a competitive basis. The selection criteria will be guided by the alignment with the national research infrastructure roadmap that will be developed based on country's research and development priorities⁶⁹. Laboratories with direct relevance to the Climate Strategic Area, including for example certification of green, ecological, or circular economy products or products related to climate smart agriculture and biodiversity preservation, will be given priority in the selection process. Laboratories to be supported by this subcomponent should be in public universities licensed by SUNEDU, IPIs, public Productive Innovation and Technology Transfer Centers (CITEs) and the National Quality Institute (INACAL).
 - b) **2.2.2 Finance research grants (US\$16.9M).** This subcomponent will co-finance grants to support research, technological development, and innovation with a demand orientation and of high relevance for the identified Strategic Areas. As part of the overall commitment of earmarking 50 percent of funds under Component 3 to the climate strategic area, at least half of the co-financed grants could be for research focused on the Climate Strategic Area and the specific climate challenges (food security, biodiversity) and opportunities (renewable energy, circular economy) identified above. Research projects eligible for this sub-component will be at a Technology Readiness Level (TRL) of 3 and below. Research conducted under this subcomponent can be advanced to higher TRLs through the academic entrepreneurship and contract research grants in sub-component 3.2. Two types of research grants will be financed:
 - (i) Grants for research and innovation projects that advance basic knowledge that may have applications in Strategic Areas, but whose results may not be transferable in the immediate term. Proposals should be presented by partnerships among at least two public or private universities, licensed by SUNEDU, one IPI, and one CITE. Grants will be allocated through competitive calls.
 - (ii) Grants to improve research and innovation capacity in STI institutions. These grants will support doctoral research projects in Strategic Areas with the main objective of promoting the quantitative and qualitative development of human capital. Grants will be allocated through competitive calls. It is expected that 290 projects will be supported. Affirmative action will be taken to encourage the participation of female candidates. Research expenses including publication expenses of recipients of Scholarships will also be financed from the proceeds of these grants.
41. **Component 3: Strengthening Industry-academia linkages to accelerate technology transfer and science-based business innovation (US\$23.7M, of which 97 percent WB funds).** This subcomponent aims to improve the relevance of R&D outputs to market demand primarily in the Strategic Areas, with at least 50 percent of overall component funding earmarked for the Climate Strategic Area, by: (i) building institutional capacity in CONCYTEC

⁶⁹ The infrastructure roadmap will be financed under this subcomponent and will build on the equipment mapping that was realized as part of the ongoing STIS operation.



and universities to enable feedback loops by identifying private sector technology and innovation needs and facilitating and accelerating technology transfers⁷⁰, and ii) closing critical innovation financing gaps needed for innovative research to reach investment-readiness and/or meet the needs of innovation-seeking firms. These activities build on those in component 2 to directly contribute to the realization and operationalization of R&D and innovative approaches that result in climate change mitigation and adaptation, health solutions, and the design of a digital economy.

42. **Subcomponent 3.1. Align demand and supply of R&D and promote industry-academia linkages (US\$5.7M)** The activities financed under this subcomponent include:

- a) **3.1.1 Conduct Competitiveness Reinforcement Initiatives for Productive Innovation (IVAs)⁷¹** in targeted regions in Peru, with a focus primarily on the Strategic Areas. The subcomponent will implement value-chain level IVAs in various regions in Peru. As part of the overall commitment of earmarking 50 percent of funds under Component 3 to the climate strategic area, half of implemented IVAs could be focused on the Climate Strategic Area and explore market segments with either mitigation potential (e.g. lower-carbon garments and textile products) through the use of circular economy approaches (e.g. waste and plastic recycling) or efficient resource use (e.g. more water efficient horticulture products) and GHG emissions reduction (e.g. regenerative agro-forestry), or adaptation potential in the identified priority areas, such as food security and biodiversity. Each initiative will: (i) identify the challenges firms face in targeted value chains and clusters in reaching higher value-add and climate-friendly market segments; (ii) define a strategy to address these challenges; and (iii) prepare a detailed Innovation Upgrading Plan (IUP). The IUPs will be jointly prepared by participating firms, universities, and support institutions with market and value chains development experts. IUPs will identify needed upgrades of production processes, investments in technology and infrastructure, research and innovation, and other actions critical for a value chain to reach more strategic markets and contribute to low carbon and climate-resilient economic growth and regional development. The IUPs will inform CONCYTEC's targeted calls for matching-grants for contract research proposals.
- b) **3.1.2 Build institutional capacity to facilitate technology transfer for the Strategic Areas.** Supported activities will include i) evaluation of existing institutional policies in supported universities and research centers for protection of intellectual property and technology transfer models; ii) capacity building and operational funding support for five competitively selected Technology Transfer Offices (TTO) in Peru (two of which would be regional and outside of Lima), and links / partnerships with international TTOs; iii) technology and commercialization mapping and early identification of scientific and technical knowledge

⁷⁰ Connecting researchers to the market – to enable the development of knowledge relevant to both private and societal benefits – has several dimensions, including the one given more prominence in the first phase of the SOP program (this project) of transferring technology arising from research activity. In modern universities there are additional activities where universities interact with the market – for example, providing technical services for public and private bodies, undertaking contract research to solve problems for firms, which is currently at a very low level in Peru, and bespoke training for professional development in advanced skills that do not necessarily lead to degree awards. It is typical that most if not all such activities in universities are combined in a single unit focused on transferring knowledge to those who wish to use it for economic and societal benefit. These will be included in subsequent phases of the SOP program, as absorption and implementation capacity in supported universities increases.

⁷¹ The first round currently being launched under component 2 of the ongoing Peru Innovation operation: the *Iniciativas de Vinculación Academia-Industria* (IVAs). Each round covers 4-8 value chains.



and research with commercial potential; iv) reinforce CONCYTEC's capacity to provide assistance to Peru's universities and PRIs that are aiming to adopt best practices for connecting researchers to markets.

43. **Subcomponent 3.2. Scaling-up technology development and innovation-based entrepreneurship** (US\$18.1M USD). This subcomponent will finance commercialization-oriented R&D activities to the extent that market and coordination failures make these very difficult to be partly or entirely financed by the private sector. The subcomponent will finance two grant windows, both of which will prioritize proposals with an explicit focus on the Strategic Areas. As part of the overall commitment of earmarking 50 percent of funds under Component 3 to the climate strategic area, at least half of financed grants in both windows could support proposals in the Climate Strategic Area. The grants in this sub-component are part of a continuum of support to research from early to later stages within the Strategic Areas. The research grants in sub-component 2.2.2 are intended to support earlier stage research (technology readiness level of 3 and below), and grants in this sub-component support closer-to-market research. Research conducted under 2.2.2 with promising commercial application can be advanced through the contract research and academic entrepreneurship activities. The implementation of grants under this subcomponent will be coordinated with the IDB-supported activities that will concurrently finance business-innovation projects aimed at closing technology gaps faced by firms.

- a) **3.2.1 Development of technologies to support value chains.** This subcomponent will support three complementary activities with a primary focus on supporting new technologies identified through the IVAs.
- **Grants for Industry-Academia contract research.** This window will finance demand-driven contract research relevant primarily to the Strategic Areas identified largely (but not solely) through IVAs conducted under subcomponent 3.1.1. The grants will be assigned based on a competitive selection process and received by universities, PRIs, and/or CITEs that will implement the contract research for, or jointly with, private sector firms. At least one large firm (or multiple firms) should be co-sponsors of the research project to reduce moral hazard and adverse selection risks, as well as to improve the chances of market access by the beneficiaries. The selection criteria will reward the amount invested by the private sector firms that are co-sponsoring the search; quality of the supply development program proposed; market size and sophistication; and degree of commitment to procure from selected beneficiaries; with priority given (at equal quality) for proposals emanating from the IVAs, and/or with explicit focus on climate mitigation and adaptation (and, as part of the overall commitment of earmarking 50 percent of funds under Component 3 to the climate strategic area, a total minimum of 50 percent of the grants could be made on climate related topics). The project's contribution will be capped.
 - **Laboratory accreditation.** This activity will finance the accreditation of laboratories to provide internationally recognized calibration and testing services. The accredited laboratories can then help Peruvian firms (including firms that participate in the IVAs) to evaluate the conformity of their products with national or international standards. An estimated 50 laboratories will be selected to receive a grant through a competitive process. Examples of eligible expenditures include preparation of documentation required for the accreditation evaluation; development of an accreditation sustainability proposal; and expert advice. Half of the supported laboratories are expected to be from the CITES network.
 - **Certification of analyzes identified for products and services in targeted value chains.** This activity will finance laboratory tests for the certification of new products identified primarily through the IVAs. These certifications are needed to show that new products conform with market quality standards.



Some of the certifications are expected to be done by laboratories that have received accreditations through the previous activity. Funds would be awarded in the form of grants to laboratories through a competitive selection process.

- b) **3.2.2 Academic entrepreneurship grants.** This window will finance academic entrepreneurship in science-based R&D primarily relevant to the Strategic Areas at advanced stages of maturity (Technology Readiness Level -TRL- 4 or higher), which might require longer-term support to reach investment readiness. Funding will be in the form of competitive grants using a two-phase approach, with universities, PRIs, and CITEs eligible to receive funding. The first phase will focus on proving the technology and estimating the likely demand. Selection criteria will include initial evidence of technical performance, market demand and likely costs of bringing the project to market. A second phase will be awarded based on the first phase to take forward projects with strong evidence of real potential. Within those boundaries, each call will have the flexibility to adjust its parameters depending on the stage of research commercialization, the field of science, and other related factors. Priority will be given (at equal quality) for proposals with explicit focus on the Strategic Areas (and, as part of the overall commitment of earmarking 50 percent of funds under Component 3 to the climate strategic area, a minimum of 50 percent of the total could be dedicated to climate topics). Affirmative action will be taken to encourage the participation of female candidates.⁷²
44. **Across Subcomponent 2.2 and Component 3.2, PROCENCIA will manage the calls for proposals and implementation of the grants on technical substance, selection criteria, and selection committees.** Eligible expenses include: i) energy efficient, when relevant, equipment and durable goods (including software and hardware); ii) materials and supplies; iii) operational expenses of the relevant grantee; iv) travel expenses of visiting researchers and academics (both to and from Peru) participating in the relevant sub-project; v) costs of incremental staff or consultants of the relevant grantee or that are otherwise necessary for carrying out the relevant sub-project; vi) expenses related to the design and application for a patent or other intellectual property rights, vii) prototype testing or validation; viii) dissemination of findings and communication about the activities under the relevant sub-project; ix) in the case of grants under component 2.1.1, enrollment fees and tuition for Eligible Students who have received Scholarships; and x) in the case of grants under component 2.2.2(b), research expenses including publication expenses of recipients of Scholarships. Land acquisition will not be financed by the project. Civil works, beyond minor internal retrofitting and/or renovation activities mainly to house new or larger equipment, are not envisioned. Where necessary, these will be limited to premises fully owned by the recipient institution and could be financed by the project provided these are of limited scale and directly linked to project-funded research. The climate, gender, and inclusion objectives of the project, and the choice of Strategic Areas, will apply to all grants. The Project Operations Manual will detail the selection criteria and process for these grant windows. The POM will detail the selection criteria and process for these grant windows.
45. **Component 4: Project Management and Monitoring & Evaluation** (US\$9.5M, of which 33 percent WB funds and 67 percent counterpart funds). This component will finance project management by a team of project coordination, technical, procurement, environmental and social, financial, and M&E specialists. The component will also cover consultancies and technical assistance that reinforce climate mitigation and adaptation measures during the implementation and support rigorous monitoring and evaluation of climate-related indicators.

⁷² The results framework targets 25 percent of technologies scaled through academic entrepreneurship grants led by women. Anecdotal evidence suggests that women-led research teams are relatively rare in Peru, so the target aims to close a gender gap.



Figure 11. Complementarity between grants



C. Project Beneficiaries

46. **The SOP will directly benefit CONCYTEC and key institutions in the SINACTI, as well as researchers and tertiary education students.** It will equip the main institutional actors with better tools for a more efficient and effective management of the SINACTI, including provision of services to the public and private sector, development of policies, programs, and instruments linked to the promotion of STI. Project interventions will benefit universities licensed by SUNEDU, public and private research institutes with laboratories, as well as members of groups, centers or research and development institutes of public and private entities and companies participating in research networks or benefiting from technology transfer support. The project will also directly benefit students, researchers and professionals that receive project funding for PhD scholarships and research projects, as well as firms and entrepreneurs that receive funding for investment in research and innovation projects. The project will also benefit females and vulnerable and underserved groups (indigenous peoples, afro-Peruanos, low socio-economic background, regions outside of Metropolitan Lima) through proactive outreach activities to encourage them to apply for grants and scholarships.
47. **The projects will also indirectly benefit:** (i) employees of universities and research centers that receive project funds; (ii) consumers that can access new and better products and services thanks to innovation; (iii) the Government through increased revenues from the value added of new activities generated or strengthened through innovation; and (iv) the climate and natural environment through the deployment of new climate adaptation and mitigation technologies. Beneficiary feedback would be captured through participation in the public-private dialogue under component 3 and the surveys on public expenditures and programs under component 1.
48. **The project has a strong citizen and beneficiary-oriented design.** The Stakeholder Engagement Plan (SEP) includes: (i) an information dissemination strategy, (ii) a consultation strategy, (iii) a strategy for the incorporation of vulnerable groups in the consultations (indigenous, afro-Peruviana, people with disabilities) and, if applicable (iv) a strategy for the participation of indigenous peoples. The SEP also includes mechanisms to address complaints, grievances and consultations. Component 3 employs a cutting-edge approach to actively engage stakeholders and beneficiaries in the project design and implementation through the Competitiveness Reinforcement Initiatives for Productive Innovation (IVAls). The IVAls include intensive participatory processes with firms, universities, and support institutions in selected value chains (within the Strategic Areas). The participatory processes (in Sub-Component 3.1.1) will allow the beneficiaries to provide feedback on their upgrading needs, which will then be codified through Innovation Upgrading Plans prepared jointly with the

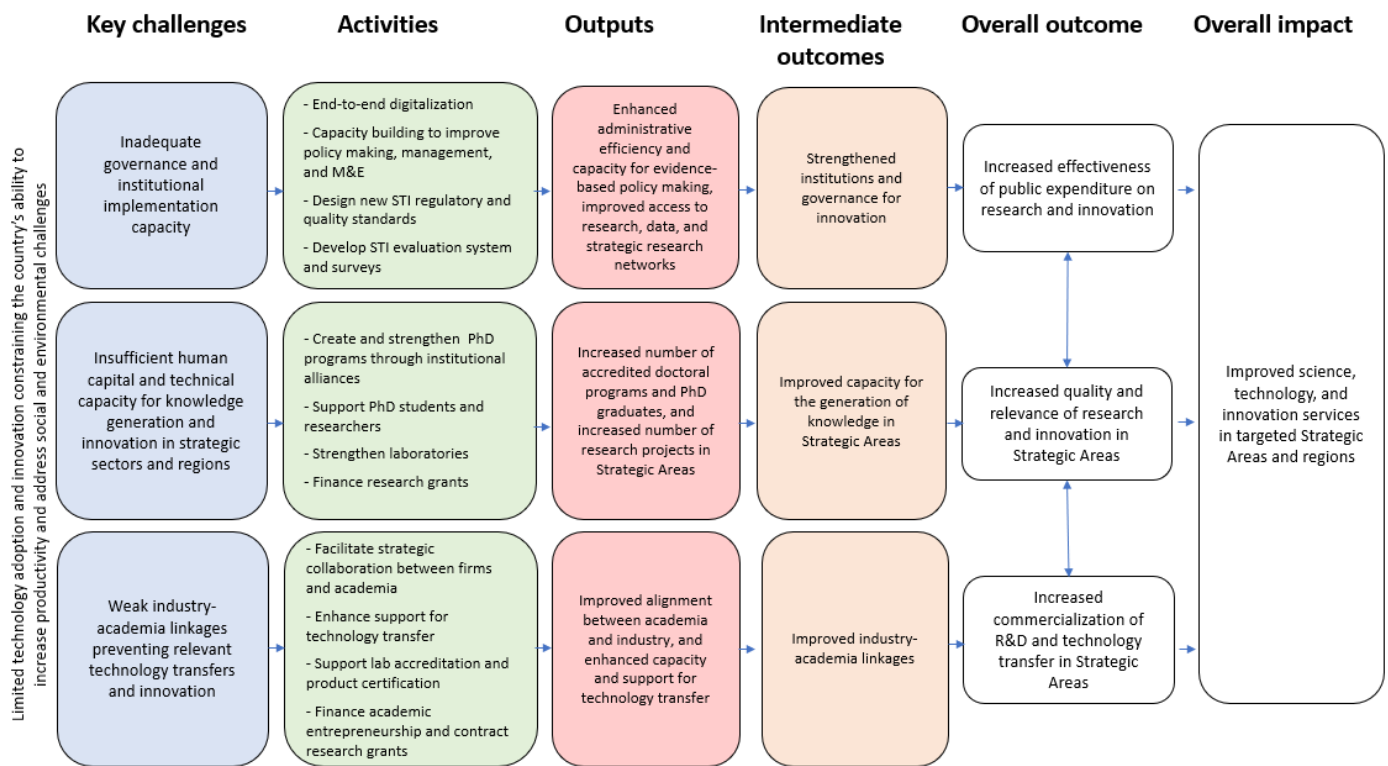


beneficiaries (firms, universities, etc.). The identified needs can then be financed through the matching grants for research in Sub-Component 3.2.1, providing a direct channel for the project to close the loop in terms of addressing the beneficiary feedback. The beneficiary feedback is captured in the results framework through the “Number of value chain focused industry-academia dialogues facilitated (IVAs)” indicator. Moreover, Component 1 will fund several surveys aimed at understanding the perceptions and needs of the public, firms, and research institutions related to STI (Sub-component 1.1.3). The results framework includes an indicator entitled “Number of STI surveys published” to track whether these surveys have been completed.

D. Results Chain

49. The theory of change (TOC) employed by the project (Figure 12) shows how proposed activities address key challenges by generating project outputs, which lead to intermediate outcomes, and contribute to the overall impact to achieve the PDO. The assumption underpinning the project’s theory of change is that addressing shortcomings at the level of innovation pull and push factors will improve the National Innovation System’s (SINACTI) ability to contribute to the competitiveness, productivity, and diversification of the economy and address key development challenges, including with regards to regional disparities, female participation in the STI system, and green growth.

Figure 12. Theory of Change



50. The logic of the theory of change follows these assumptions:

- (a) Strengthening CONCYTEC’s capacity as a governing body for the SINACTI, and more broadly strengthening the coordination and management capacity of key institutional actors (PRIs and



universities), will greatly enhance the efficiency and effectiveness of public expenditure on innovation and evidence-based and regionally informed policymaking;

- (b) Increasing the quantity of qualified researchers and PhD graduates will contribute to an increase in the quantity and quality of research outputs, collaborative R&D projects, and knowledge sharing;⁷³
- (c) Improving academia-industry linkages⁷⁴ and access to financing in critical stages where private sector investment is rarely available (pre-investment readiness and start-up phases) will improve the alignment between R&D outputs and market needs, therefore improving the returns on R&D investment in terms of innovation in the real economy.⁷⁵

51. The intermediate outcomes of the projects are expected to contribute to a more efficient and effective SINACTI that supports competitiveness and sustainable economic growth in Peru.

E. Rationale for Bank Involvement and Role of Partners

52. **Public sector financing to achieve the targeted benefits is justified because project activities will address numerous market and coordination failures associated with the intrinsic nature of the innovation process,** which often make the social benefits of innovation higher than the private benefits and lead to levels of innovation that are lower than is socially desirable. The project is investing in public goods and activities to overcome market, government, and coordination failures, including: (i) asymmetric information, positive externalities, and coordination failures that lead to underproduction of relevant scientific research; (ii) uncertain returns to innovation and fear of appropriability that lead to suboptimal private sector investment; and (iii) intangible assets not amenable to traditional financing which limit access to finance for innovation. The project aims to also increase the quality and relevance of scientific research leading to increased commercialization and private investment in R&D, and through de-risking the financing of spinoffs, crowd-in private venture capital.

53. **The rationale for public vs. private spending is particularly high at low levels of technology readiness and diminishes as the technology readiness level (TRL) increases (fig. 12).** Public funding is most strongly justified and tends to constitute the highest share of spending for low levels of TRL where the risk of failure is the highest but the potential public benefits from basic knowledge and discovery are also substantial. The main beneficiaries at this end of the spectrum of the knowledge and innovation market are academia, PRIs, and TTOs and the proposed SOP will support them through capacity building in component 1 and research and PhD grants in component 2. At higher levels of TRL, such as prototype and laboratory testing, public funding can still be needed to optimize positive externalities such as market and job creation, as well as the pursuit of solutions to socio-economic challenges. The SOP will provide support through matching grants for contract research and academic entrepreneurship grants in component 3, which will also benefit innovation-seeking firms.

54. **As a current and long-term strategic partner in Peru's national innovation system development, the WB is well positioned to complement and advance the efforts by the government.** The government has sought WB involvement for three main reasons: (a) the ability of the Bank to mobilize and bring international best practices and global knowledge and expertise to bear on the strengthening of the national innovation system; (b) the need for long-term, strategic, and stable financing to implement a range of integrated programs that will help to achieve long-term and sustainable economic growth; and (c) the deep knowledge the WB has developed over the past 4 years by financing and technically supporting most of the key actors in the national innovation system

⁷³ In addition to improving the quality of higher-education and its outputs in terms of skilled labor.

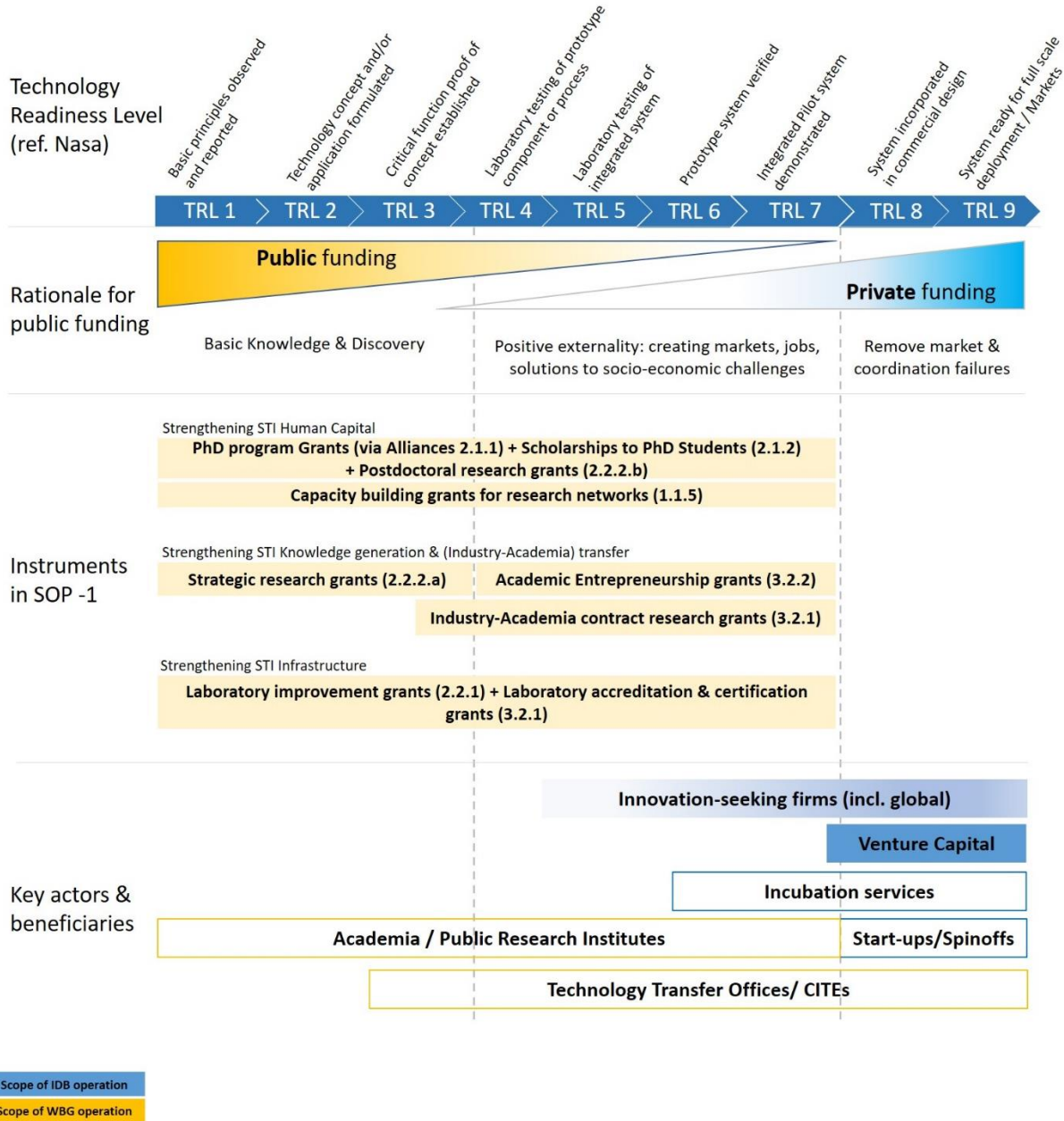
⁷⁴ Via increased technology transfer capacities and improved Industry – academia dialogue in innovation seeking value chains.

⁷⁵ Measured by increased number of spinoffs and/or commercial returns on patents.



(SINACTI), including CONCYTEC as the governor of the system (through the ongoing STIS operation), PRODUCE (through the PENIPA IPF), and Ministry of Agriculture (through the PNIA IPF).

Figure 13: Rationale of public (vs private) spending in knowledge and innovation market



F. Lessons Learned and Reflected in the Project Design

55. **Ongoing WBG engagements in Peru have delivered a range of short-term results.** For example, the STIS project has financed 190 applied research and technological development projects with the participation of more than 2,200 researchers; the improvement of research infrastructure of 17 laboratories; the funding of 10 doctoral



programs with the participation of 98 fellows, and the support of 100 startups with a capacity building program and improved access to markets. Finally, the STIS operation recently started piloting competitive grants to fund potentially commercially viable R&D generated in public and private institutions, as well as value chain specific Public Private Dialogues to better align supply of R&D with market needs in the real economy. PNIA also financed 600 innovation sub-projects in the areas of applied research (59), adaptive research (129), extension (367), and seed systems (45), reaching more than 41,000 producers, 762 institutional beneficiaries (including public and private research institutes, universities and technology institutes, private firms, NGOs, producer organizations and public institutions), and leveraging around S/- 36 million in counterpart funding. PNIPA has so far financed 1,324 innovation sub-projects (237 in fisheries and 1,087 in aquaculture) through four windows: (1) applied research (135 sub-projects), (2) adaptive research (90 sub-projects), (3) extension (899 sub-projects), and (4) capacity building (200 sub-projects). In addition, 13 non-competitive sub-projects have been commissioned to address sectoral priorities, especially including overcoming weaknesses in sanitary and phytosanitary systems in the fisheries and aquaculture sector.

56. **The design of the project has been greatly informed by lessons learned from these ongoing innovation operations, particularly STIS (P156250),** and its ongoing Public Expenditure Review of the SINACTI, its capacity building program for Industry-Academia linkage Initiatives – IVAIs – and its substantial support to the PhD programs and R&D in public universities. Lessons learned from the current STIS operation include:

- (a) The institutional capacity of the implementing agency was weakened rather than strengthened when the policy focused CONCYTEC merged with the Implementation/Operations focused FONDECYT. Instead of streamlining and simplifying clearances (e.g., on procurement), processes were duplicated between various teams (project team and CONCYTEC admin teams). The current STIS operation was eventually restructured to assign implementation to FONDECYT only (under its new name, PROCENCIA), while ensuring that CONCYTEC staff continue to lead on matters of technical substance (e.g., TORs, evaluation committees). It must be noted that even with a clearer structure of workflows, there is a strong need to reinforce both: i) the PIU with highly qualified staff in matters of WB fiduciary guidelines and processes; and ii) CONCYTEC technical departments with relevant experts. These lessons are adopted by this project and reflected in its institutional arrangements and the new Project Operations Manuals, where a lot of emphasis is placed on anticipating needs for institutional capacity support. The implementation arrangements also reflect lessons learned from a similar innovation project in Uruguay, which found that making a single agency responsible for project implementation improves project coordination, efficacy, and efficiency.⁷⁶
- (b) Many universities have significant challenges implementing research projects, constrained by burdensome procedures or lower implementation capacities. Errors in processing the paperwork of some of the foreign or returning researchers, and other procurement delays have led to complaints and grievances by researchers. The adoption of the 'Alliance' approach (component 2.1), where the most experienced universities may function as an anchor and lead a group of institutions that includes less experienced ones, allows to address many of these challenges by building on the capacities of the anchor university and creating economies of scale that justify the systemic recruitment of logistic and support services needed by each Alliance to deliver planned activities.

⁷⁶ Implementation Completion and Results Report. 2015. *Promoting Innovation to Enhance Competitiveness (P095520)*. Uruguay.



- (c) The focus of innovation-related development finance projects in Peru has so far been either on the supply of knowledge (e.g., research in academia and public institutes, PhDs), or on the private sector demand for R&D (e.g., technology adoption or investment in internal R&D services). Less attention has been given to the subtle but critical area of 'connecting' research to market. A key aspect of this connection is ensuring that produced knowledge is relevant both for the private sector, as well as for public interest societal benefits. The main activities that can facilitate the connection of research to market include: promoting market focused / value chain focused academia-industry dialogue on prospective innovation and technology needs; transferring technology arising from research activity; undertaking contract research to solve problems for firms; facilitating Academia/PRIs in providing technical services for public and private bodies, and bespoke training for professional development in advanced skills that do not necessarily lead to degree awards. Typically, most, if not all, such activities in universities are combined in a single unit with low absorption and implementation capacity. The proposed project will strengthen the connection between supply and demand in the innovation ecosystem through support for industry-academia dialogue, technology transfer capabilities, and contract research. The project will also initiate reforms of PRIs that aim to provide services to private and public bodies.
- (d) Eight Industry-Academia public private dialogues are being facilitated under the current STIS operation in Peru. They have generated strong participation and provided data-based evidence, based on market analytics, that market demand in seven out of the eight pilot value chains is increasingly sensitive to climate change mitigation and adaptation, requiring firms (and relevant R&D) to innovate and meet this evolving trend. The new project will build on this policy-informing momentum and strongly focus on green or greening value chains, bioeconomy, circular economy, and health.
- (e) Managing the firm-level support program for startups under the current STIS project is proving to be more challenging for CONCYTEC/PROCIENCIA than originally anticipated, suggesting that such activities would be more effective if the implementing agency includes firm-level support in its core services (e.g., ProInnovate). The ongoing randomized control trial (RCT) impact evaluation of the program will provide a comprehensive analysis and inform the opportunity of scaling it in future projects in the SOP. The impact evaluation can also be useful for other projects in Peru financed by the government, WBG, or development partners.
- (f) The RCT-based Impact Evaluation approach itself, however, has instigated strong interest and buy-in by CONCYTEC's and PROCIENCIA's monitoring departments, and is poised to be applied in the SOP since the number of eligible beneficiaries is likely to be significantly higher than what the project can afford to support. In such cases, the application of a randomized selection might be possible, and be leveraged to conduct further RCT-based IEs on programs and activities, therefor better informing future policy and programs.
- (g) A much longer timeline is needed for outputs and impacts to emerge from investments related to R&D (e.g., institutional governance, development of research and technology, PhDs and related outputs, development of investment ready research products and technology transfer). The critical activity of capacity building of institutions (e.g., CONCYTEC, Universities) take a substantial time to take hold and improve performance on the implementation of key activities (e.g., PhD programs). The current efforts



to build the capacity of universities and CONCYTEC-FONDECYT highlight the importance of longer-term constancy and a gradual approach to adapt to absorption capacity of recipient institutions. This is consistent with lessons learned from similar WB projects in Argentina, Uruguay, and Colombia and from OECD countries, which suggests that it takes a long time and policy consistency for National Innovation Systems to develop. Impacts on the private sector also requires longer term horizons: a research project can take multiple years before it reaches proof of concept, at which point a range of further R&D activities are needed (supported by the project) to reach investment readiness, and then spin off into the private sector and lead to a patent application. An SOP not only offers a more adequate timeline, but it also offers the opportunities to learn from the early project and investments to improve and adjust the later projects. Continuity and consistency of effort over a duration like the proposed Peru SOP proved crucial in recent Bank projects in Argentina where substantially similar development objectives were achieved.

III. IMPLEMENTATION ARRANGEMENTS

A. Institutional and Implementation Arrangements

57. **The implementing agency for this project is the National Scientific Research and Advanced Studies Program (PROCIENCIA).** PROCIENCIA is an agency that depends on the National Science, Technology, and Innovation Council (CONCYTEC). As one of the two main operational institutions (along with PROINOVATE) responsible for the implementation of national STI programs, and the one formally in charge of implementing funding dedicated to research in universities and public institutions, PROCIENCIA will be responsible for all administrative, fiduciary, and safeguards functions of the project, as well as the management of the grant and scholarship competitive funds.

58. **PROCIENCIA was created in July 2021 by absorbing FONDECYT, giving it significant experience in implementing STI programs.** FONDECYT (National Fund for the Development of Science, Technology, and Technological Innovation) was previously the operational arm of the CONCYTEC, with responsibility for managing programs to support basic and applied research, technology transfer, and higher education. FONDECYT was the implementing agency for the World Bank-financed *Strengthening the Science, Technology, and Innovation System in Peru* project (STIS; P156250) initiated in 2018. Following Law 31520, PROCIENCIA is in the process of absorbing the responsibilities and capabilities of FONDECYT, including to implement the STIS project.⁷⁷ This gives FONDECYT/PROCIENCIA significant operational experience in managing STI support programs. PROCIENCIA is expected to continue to be staffed with technical, procurement, financial management, disbursement, and safeguard specialists (in prolongation of its current capacities under the ongoing STIS project). PROCIENCIA will be responsible for requests of disbursements from the Bank, as well as for the preparation of the annual audits and their submission to the Bank.

⁷⁷ The creation of PROCIENCIA responded to the need to optimize the use of public resources and avoid overlapping mandates and functions in the areas of scientific research, human capital formation, technological development, and innovation. PROCIENCIA has a fifteen-year operational time frame after the finalization of the fusion process with FONDECYT. An effectiveness condition of the project is that the Borrower has provided evidence satisfactory to the Bank that PROCIENCIA has initiated operations in accordance with the fifth final supplementary provision of Supreme Decree No. 051-2021-PCM creating PROCIENCIA (i.e., that the FONDECYT-PROCIENCIA merger process has concluded).



59. **CONCYTEC will play a key technical management and oversight role.** CONCYTEC is the agency in charge of the SINACTI (National Science, Technology, and Innovation System) and it falls under the Presidency of the Council of Ministries (PCM). CONCYTEC will be in charge of the technical design of the project interventions, the preparation of the general and specific project operations manuals (including any changes to the manuals), the preparation of the TORs, impact evaluations, and the technical supervision of the implementation of the activities that aim to strengthen SINACTI, as well as any activities that require special technical supervision. In sum, CONCYTEC, as the governing institution in the area of science, technology and innovation, is responsible for the design of all financial instruments under the Project, while PROCENCIA is responsible for their execution.
60. **Based on the lessons learned from the ongoing STIS Project** (see section II.F above), CONCYTEC-FONDECYT and the Bank agreed that a new institutional arrangement (described above) would be required for this new project, to ensure a streamlined implementation approach. The existing Project as already been restructured to take on this new institutional arrangement.

B. Results Monitoring and Evaluation Arrangements

61. **The M&E system for the SOP will follow the results framework outlined in Annex 1.** The project will build on existing M&E systems in PROCENCIA and component 1 will support the development and enhancement of M&E systems. Several results will be disaggregated by gender and climate financing as indicated in the results framework. PROCENCIA will prepare semiannual reports with data for the results framework, to be reviewed and discussed with the World Bank Group. The results framework data will be captured in Implementation Status and Results reports that the World Bank team will prepare periodically. Implementation support provided by the World Bank team will also enhance results M&E. Thus, progress against objectives will be assessed on an ongoing basis.
62. **An adaptive learning process will be designed and wired into the M&E strategy and results framework.** The M&E system will generate regular, real-time data to allow for flexibility and mid-course correction. Building on frequent data collection for intermediate indicators, the program will refine the design of the next projects in the SOP. Intermediate objectives will be set at midterm of the first project, which can then serve as 'triggers or proxy measures for the opportunity to start preparing the second project (or third project if deemed necessary).
63. **Building on the experience and capacity building in randomized control trial (RCT) impact evaluations acquired during the current STIS project,** PROCENCIA will aim to apply RCT-based impact evaluations to grant windows where the number of eligible and qualified applicants largely surpasses the availability of funds. The randomized system will ensure a perception of fairness in the selection of beneficiaries (among the larger pool of qualified and eligible firms), while helping measure with higher accuracy the impacts of the program.

C. Sustainability

64. **The likelihood of sustaining project benefits beyond the implementation timespan of the project is high.** The interventions under component 1 will contribute to a more effective and efficient governance of the SINACTI, better institutional coordination and improved design and implementation of programs. Investments under component 2 will help attract and strengthen human capital in STI and align the production of research outputs



with demonstrated demand from the private sector, as well as with Peru's social and environmental priorities, such as green growth and regional development. Component 3 will contribute to the creation of a better alignment between the focus areas of the SINACTI and private sector needs, fostering new productive linkages between firms and academia, which should gradually increase the direct investment of the private sector in innovation and R&D, including in collaborative projects with key institutions of the SINACTI that are beneficiaries of this project. The SOP approach serves to further strengthen sustainability by building on and strengthening capacities developed under prior projects in the series.

65. **The sustainability of the project is also demonstrated by the close alignment of proposed activities with national-level competitiveness and science and innovation policies.** The development of a robust science, technology and innovation system is a high priority in the development agenda of Peru, as evidenced by the launch of PROCIENCIA in March 2021. PROCIENCIA aims to ensure the coordination of science, technology and innovation activities, and the efficient use of public resources under a modern public management system. PROCIENCIA is directly administered by CONCYTEC, itself directly under the purview of the Presidency of the Minister's Council, a high-level decision-making body with representatives of relevant Ministries.

IV. PROJECT APPRAISAL SUMMARY

A. Technical, Economic and Financial Analysis (if applicable)

66. **A comprehensive economic analysis of the project was done by the government as part of the requirements for Peru's public investment system (Invierte.pe).**⁷⁸ The economic analysis, with some minor adjustments by the WB, is summarized in Annex 2. It finds that the private and social benefits of the project exceed its social costs. Private benefits are related to the gains obtained from sales of more innovative products and services by the innovating firms, as well as the additional fiscal revenues the state can collect associated with those gains. Social benefits are related to the additional consumer surplus obtained by the reduction in product prices and/or the increment in the quality of existing goods. Overall, the project net present value is estimated at US\$6.8 million (PEN25 million) at an 8 percent social discount rate. The calculations take into account the social benefits expected over a 10-year horizon for the cases of increased innovation and research, and 15 years for the increase in the number of researchers with PhDs. Taking into consideration all the components, the economic rate of return of the project is 9.4 percent.

B. Fiduciary

(i) Financial Management

67. **A Financial Management Assessment (FMA) was carried out from September to November 2021 to evaluate the adequacy of FM arrangements for the implementation of the Project.** The FMA recommends a set of mitigating measures to address the main FM challenges. Once the mitigation measures are in place, the proposed FM arrangements will meet the Bank's minimum fiduciary requirements.
68. **Summary of FM and Accountability arrangements.** The FM risk for this Project at this stage is considered

⁷⁸ See *Estudio de Preinversión a Nivel Perfil "Mejoramiento y ampliación de los servicios de CTI para Fortalecer el Sistema Nacional de Ciencia, Tecnología e Innovación"*, June 2021.



Substantial. The Project will be implemented by the *Programa Nacional de Investigación Científica y Estudios Avanzados* (PROCIENCIA), that is a project implementing unit (PIU) of the *Consejo Nacional de Ciencia, Tecnología e Innovación Tecnológica* (CONCYTEC). CONCYTEC is an entity adscript to the Ministry of the Presidency (PCM) and will be responsible for the technical design, oversight, and approval of deliverables of the project. PROCIENCIA is a new project implementing unit (PIU) created by absorbing the previous PIU FONDECYT which is implementing the project Strengthening the Science, Technology, and Innovation System Project I (STIS, P156250) partially financed with Bank funds. PROCIENCIA, once fully operative, will have an independent budgetary line and administrative and fiduciary autonomy. Thus, PROCIENCIA (ex-FONDECYT) has previous experience implementing projects financed through WB proceeds. It is expected that PROCIENCIA will assign part of its own staff and hire new staff in order to create a dedicated project management team (PMT). The fiduciary aspects of the Project will fall under the responsibility of the Administration Unit (AU) within PROCIENCIA. Yet, considering the additional financial work that the project may cause, the PMT of the PROCIENCIA will have, as minimum FM staff, a financial management specialist and a budget and planning specialist, with working experience in WB-financed projects, dedicated to the project. The FM arrangements for this Project will be straightforward; however, components 2 and 3 include transfers of funds (Grants) to several entities (such as universities, public research institutes (PRIs) and innovation technology centers (CITEs) which will require specific financial arrangements. Peru's central government has sound public FM systems and the project implemented by PROCIENCIA will benefit from the use of such country systems in the areas of budgeting, flow of funds, accounting, and auditing, as well as from the use of public financial information system SIAF.

69. **Main FM risks and mitigating measures.** The FM dimension of the project could be affected by the following main risks and challenges: (i) PROCIENCIA is pending becoming fully operational with respective access to the public financial systems and budget allocation; (ii) delays in budget allocation of resource for the project (both WB and counterpart); (iii) shortage of staff to cope with additional project fiduciary workflow; (iv) lack of integration of financial information systems to produce timely and accurate financial reports, subproject reports, and justification of expenditures for the Bank; (v) delays in monitoring the justification of expenditures by the grant executing units (such as universities, among other institutions); and (vi) delays in the execution of funds due to slow coordination among the technical and administrative teams of CONCYTEC and PROCIENCIA; and (vii) pending definition of the FM chapter of the MOP including audit arrangements.
70. **The proposed mitigating measures for managing the Project's FM risks include:** (i) PROCIENCIA should become completely operative (effectiveness condition); (ii) the Project Management Team of PROCIENCIA should have as minimum FM staff a financial management specialist and a budget and planning specialist, with working experience in WB-financed projects, recruited under terms of reference satisfactory to the WB (legal covenant); (iii) the Budget and Planning Office shall follow-up and ensure that all the resources of financing are timely and properly allocated after effectiveness (iv) develop an interface among the subproject monitoring system and the financial information system to avoid delays and possible misstatements in the financial reports (dated covenant); (v) complete the operational manual, including the financial management (FM) chapter: financial report formats, processes, procedures, roles, and responsibilities for the administrative team within PROCIENCIA to comply with Bank requirements to manage the Project (effectiveness condition); (vi) complete a specific operational manual (MOEs) for subprojects (grants) with processes and procedures for an adequate monitoring of subproject funds (dated covenant); and (vii) define terms of reference for the external audit, taking into consideration the specific risks identified for this Project. The overall conclusion of the FM assessment is that once the mitigating measures have been put in place and the pending activities concerning staffing, budget, accounting, reporting, and internal controls have been defined, then the proposed FM arrangements will meet



the World Bank’s minimum fiduciary requirements.

(ii) Procurement

- 71. **Procurement activities will be carried out by PROCENCIA according to the World Bank’s Procurement Regulations** for IPF Borrowers, dated November 2020, for the supply of goods, non-consulting, and consultant services under the project.
- 72. **The World Bank carried out from September to November 2021 a procurement capacity assessment of PROCENCIA** that will be the executing entity for this operation with the input of CONCYTEC's technical teams. PROCENCIA is a recently created institution (through Supreme Decree of March 2021) that absorbs FONDECYT by merger. The assessment concluded that PROCENCIA (ex-FONDECYT) has increased its experience in procurement under World Bank Guidelines over the past 3 years, running the current Bank-financed project (phase I). It has done so via a complex management structure with CONCYTEC. For the implementation of this new project, it will need to hire and maintain throughout project execution professional(s) qualified with enough experience in procurement under World Bank’s Procurement Guidelines and/or Regulations (at least two procurement specialists with a support team). The professional(s) should be fully dedicated to the Project and adequately respond to procurement activities at the central and sub-project levels. A mitigation plan to strengthen the procurement capacity of PROCENCIA is included in Annex 1.
- 73. **PROCENCIA has developed a Project Procurement Strategy for Development (PPSD) that establishes the best procurement arrangements to ensure value for money while efficiently achieving the PDO.** The PPSD concluded that Project's resources will be concentrated around 25 percent on procurable expenses of consulting services, goods and non-consulting services directly performed by PROCENCIA, and 75 percent for subprojects awarded through grants (open and competitive calls) whose procurement activities will be carried out by each Eligible Grantees of each subprojects' implementation. The PPSD focuses on the high-risk and high-value contracts and summarizes the operational environment in which the project will be implemented, the market analysis, the risk assessment, and the analysis of different approaches to carry out the procurement for these activities (more details are provided in Annex 1). A Procurement Plan covering at least the first 18 months of project implementation has been prepared by PROCENCIA based on PPSD results.

C. Legal Operational Policies

	Triggered?
Projects on International Waterways OP 7.50	No
Projects in Disputed Areas OP 7.60	No

D. Environmental and Social

- 74. **The proposed environmental and social risk classification for the Project is Moderate under the WB’s Environmental and Social Framework (ESF).** Given the nature and scale of activities, low to moderate environmental, health, and safety (EHS) risks and potential impacts are expected, mainly associated with applied research (both in research institutions and the field), technological development, and laboratory equipment



activities. These risks and impacts are expected to be: (i) temporary and/or reversible; (ii) mainly low (to moderate) in magnitude and not expected to cause serious adverse effects to human health and the environment, even though project activities could be located within natural and critical natural habitats; (iii) site-specific; and (iv) easily mitigated in a predictable manner. The Appraisal Stage ESRS contains a detailed description of expected EHS and social risks and impacts.

75. **To adequately address and mitigate the Project's EHS and social risks and impacts, the Borrower has prepared:** (i) an Environmental and Social Management Framework (ESMF)⁷⁹, with the principles, guidelines and procedures to assess the environmental and social risks and impacts of each intervention, in compliance with both national requirements and relevant standards. The ESMF includes an Exclusion List with non-eligible interventions, including civil works, interventions with substantial and high E&S risks, activities which would require Free, Prior and Informed Consent (FPIC) with indigenous peoples, among others. It also details the process for developing, approving, and implementing the Environmental and Social Management Plans (ESMPs) of each intervention to be financed under the call for proposals of components 2 and 3, including all the necessary E&S management measures in compliance with relevant ESF standards and national regulations; and ii) a Stakeholder Engagement Plan (SEP)⁸⁰ with a stakeholder communication strategy. These documents have been drafted and disclosed in both the WB's and CONCYTEC's websites in draft versions prior to project's appraisal, on November 12, 2021, together with the Environmental and Social Commitment Plan (ESCP).⁸¹ Finally, the Borrower will prepare and disclose Labor Management Procedures (LMPs) prior to project effectiveness, as stated in the ESCP.

V. GRIEVANCE REDRESS SERVICES

76. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to the Project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit <http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service>. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

⁷⁹ <https://www.gob.pe/institucion/concytec/informes-publicaciones/2342595-marco-de-gestion-ambiental-y-social-mgas>;
<https://documents.worldbank.org/en/publication/documents-reports/documentdetail/911211636719232685/environmental-and-social-management-framework-esmf-strengthening-perus-national-science-technology-and-innovation-system-p176297>

⁸⁰ <https://www.gob.pe/institucion/concytec/informes-publicaciones/2304095-plan-de-participacion-de-las-partes-interesadas-pppi>;
<https://documents.worldbank.org/en/publication/documents-reports/documentdetail/648211636755426371/stakeholder-engagement-plan-sep-strengthening-perus-national-science-technology-and-innovation-system-p176297>

⁸¹ <https://www.gob.pe/institucion/concytec/informes-publicaciones/2342837-plan-de-compromisos-ambientales-y-sociales-pcas>;
<https://documents.worldbank.org/en/publication/documents-reports/documentdetail/398541636755402857/environmental-and-social-commitment-plan-escp-strengthening-perus-national-science-technology-and-innovation-system-p176297>



VI. KEY RISKS

77. **Overall, the project risk rating is assessed as “Substantial”**, mainly due to the fiduciary, institutional capacity, and political and governance risks. Risks associated with the macroeconomic context, sector strategies and policies, technical design, and environment and social are moderate or low.
78. **Fiduciary risk:** Substantial. (i) CONCYTEC is currently executing a project financed by the Bank (STIS, P156250), through FONDECYT as a PIU, whose fiduciary performance has shown some important shortcomings that have impacted the current project implementation, (e.g., lack of clarity in roles, responsibilities and internal procedures, failures in the maintenance and control of the procurement processes records, delays in some procurement processes, and low fiduciary capacity mainly due to the specialist's high turnover of Financial Management (FM) and Procurement); (ii) PROCIENCIA, a recently created institution absorbs FONDECYT by merger; the transition from the current legal structure (FONDECYT) to the new one (PROCIENCIA) is currently underway; and (iii) most of the procurement will be carried out by grants beneficiaries, adding complexity to procurement management by PROCIENCIA. Fiduciary risk mitigation measures and capacity building actions are identified and included in the FM and procurement mitigation plans. Fiduciary mitigation measures relate to, inter alia, appropriate planning; staffing within PROCIENCIA; definition of roles, responsibilities, procedures, and reporting in the Project Operational Manual; training; files and documentation management; and monitoring and supporting for sub-projects.
79. **Institutional capacity for implementation and sustainability risk:** Substantial. A number of complex and cutting-edge activities are needed and foreseen in this project to strengthen Peru's STI system. CONCYTEC and PROCIENCIA's institutional capacity will have to meet the challenge of providing efficient management and sophisticated technical knowhow, which are essential to successfully implementing said activities. To that effect, the reform of SINACTI has already significantly reinforced PROCIENCIA's capacity (formally FONDECYT) to implement its mission, by providing it more autonomy and means to implement such projects. It has also reinforced the role of CONCYTEC as governing body of SINACTI, with a mandate for technical oversight on innovation policy action. However, as the implementation of this new regulatory and administrative context remains nascent, the risk remains Substantial that it could not meet the planned outcome. To mitigate that risk, capacity building investments are foreseen in the operation, in ways that draw very concrete and operational lessons from the ongoing STI project. These includes allocations of funds to recruit 'in house' consultants that will accompany CONCYTEC (specific departments with technical supervision roles) in the redaction of technically sophisticated TORs, the evaluation of technical proposal during the procurement process of key consultancies, and the quality control of outputs. It also includes a strong reinforcement of PROCIENCIA in areas such as procurement and financial management. Finally, project preparation has invested significant efforts in the preparation of the Project Operation Manual, with special emphasis on impact-critical activities (e.g. competitive grants, capacity building of third parties such as TTOs and PRIs). Finally, Component 1 is also designed to modernize and strengthen (and digitalize) the capacity of CONCYTEC and PROCIENCIA on the mid-long run, and support the implementation of the SINACTI reform.
80. **Political and governance risk:** Substantial. Peru has a track record of frequent changes in leadership and staffing at counterpart agencies. While investments in innovation have been systematically endorsed by all governments in the past decade, with a leading role for the Ministry of Economy and Finance in the monitoring of progress on results in this area, frequent changes in government could create uncertainty regarding the continued prioritization of this agenda. Recently, Congress has questioned the role of SUNEDU, the entity responsible for



the oversight of higher education institutions, and advanced legislative reform proposals, at the same time as further incidences of conflict of interest between congress members and private universities came to light. However, the support of the Executive for SUNEDU has been maintained.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

COUNTRY: Peru

STRENGTHENING PERU'S NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM

Project Development Objectives(s)

The objective of the Project is to improve science, technology, and innovation services in targeted Strategic Areas and regions.

Project Development Objective Indicators

Indicator Name	PBC	Baseline	End Target
To improve science, technology and innovation services in targeted Strategic Areas and regions			
Public STI Institutions with adequate operational capacity (Number)		8.00	24.00
PhD students receiving project-funded scholarships at supported doctoral programs (Number)		0.00	290.00
New or updated technologies developed by consortia targeting value chains and innovative firms (Number)		0.00	90.00

Intermediate Results Indicators by Components

Indicator Name	PBC	Baseline	End Target
Component 1: Strengthening SINACTI's institutions and governance to bolster innovation in Peru			

Indicator Name	PBC	Baseline	End Target
Digitization of CONCYTEC completed (Yes/No)		No	Yes
STI surveys published and feedback used for decision-making (Number)		0.00	5.00
Public Research Institutes that have prepared a diagnostic and road map for reform (Number)		0.00	5.00
Component 2: Capacity development for the generation of knowledge in Strategic Areas			
Operational institutional alliances for the development of research capabilities (Number)		0.00	8.00
Operational institutional alliances of which are focused on climate-related research (Number)		0.00	4.00
PhD students receiving project-funded scholarships at supported doctoral programs in the climate Strategic Area (Number)		0.00	145.00
Female PhD students receiving project-funded scholarships at supported doctoral programs (Number)		0.00	116.00
Strengthened and equipped research labs (Number)		0.00	30.00
Research projects launched to strengthen capabilities in STI institutions (Number)		0.00	290.00
Component 3. Strengthening Industry-academia linkages to accelerate technology transfer and science-			
Value chain focused industry-academia dialogues facilitated (IVAs) (Number)		0.00	8.00
IVAs developed focused on value chains outside of the Metropolitan Area of Lima (Number)		0.00	4.00
IVAs developed focused on the climate Strategic Area (Number)		0.00	4.00
Technology Transfer Offices (TTOs) strengthened (Number)		0.00	5.00
TTOs strengthened outside of the Metropolitan Area of Lima (Number)		0.00	2.00
Technologies and R&D and innovation processes developed by consortia targeting value chains and innovative firms in the		0.00	45.00

Indicator Name	PBC	Baseline	End Target
Climate Strategic Area (Number)			
Tests required by value chains certified by labs (Number)		0.00	20.00
Technologies scaled to higher level of technological readiness (TRL) through academic entrepreneurship grants (Number)		0.00	12.00
Technologies scaled to higher level of technological readiness (TRL) through academic entrepreneurship grants of which are within the climate Strategic Area (Number)		0.00	6.00
Technologies scaled to higher level of technological readiness (TRL) through academic entrepreneurship grants of which are led by women (Number)		0.00	3.00
Loan proceeds under Components 2 and 3 applied to activities in the climate Strategic Area (Percentage)		0.00	50.00

Monitoring & Evaluation Plan: PDO Indicators

Indicator Name	Definition/Description	Frequency	Datasource	Methodology for Data Collection	Responsibility for Data Collection
Public STI Institutions with adequate operational capacity	Adequate operational capacity is defined in terms of STI outputs produced, e.g., publications, patents, and partnerships, or equivalent. Threshold values of outputs will be defined in the Project Operational Manual.	Annual	TBD		PROCIENCIA

PhD students receiving project-funded scholarships at supported doctoral programs		Annual	Project data		PROCIENCIA
New or updated technologies developed by consortia targeting value chains and innovative firms	Technologies should be developed to a technological readiness level of 7 (TRL7).	Semi-annual	Project data		PROCIENCIA

Monitoring & Evaluation Plan: Intermediate Results Indicators

Indicator Name	Definition/Description	Frequency	Datasource	Methodology for Data Collection	Responsibility for Data Collection
Digitization of CONCYTEC completed		TBD	Project data	TBD	PROCIENCIA
STI surveys published and feedback used for decision-making	This is a Beneficiary feedback indicator. It includes surveys on public perception of STI, R&D in companies, technology adoption in companies, activities in science and technology, and scientific equipment in research centers. These all have the aim of soliciting feedback from the public and beneficiaries on project-related themes.	Semi-annual	Project data		PROCIENCIA
Public Research Institutes that have prepared a diagnostic and road map for reform		Semi-annual	Project data		PROCIENCIA

Operational institutional alliances for the development of research capabilities		Semi-annual	Project data		PROCIENCIA
Operational institutional alliances of which are focused on climate-related research		Semi-annual	Project data		PROCIENCIA
PhD students receiving project-funded scholarships at supported doctoral programs in the climate Strategic Area		Annual	Project data		PROCIENCIA
Female PhD students receiving project-funded scholarships at supported doctoral programs		Annual	Project data		PROCIENCIA
Strengthened and equipped research labs		Semi-annual	Project data		PROCIENCIA
Research projects launched to strengthen capabilities in STI institutions		Annual	Project data		PROCIENCIA
Value chain focused industry-academia dialogues facilitated (IVAs)	This is a Beneficiary Feedback indicator, as the IVAs include intensive participatory processes with firms, universities, and support institutions in selected value chains (within the Strategic Areas). The participatory processes will allow the beneficiaries to provide feedback on their upgrading needs, which will then be codified through Innovation Upgrading Plans prepared jointly with the	Semi-annual	Project data		PROCIENCIA

	beneficiaries (firms, universities, etc).				
IVAs developed focused on value chains outside of the Metropolitan Area of Lima		Semi-annual	Project data		PROCIENCIA
IVAs developed focused on the climate Strategic Area		Semi-annual	Project data		PROCIENCIA
Technology Transfer Offices (TTOs) strengthened		Semi-annual	Project data		PROCIENCIA
TTOs strengthened outside of the Metropolitan Area of Lima		Semi-annual	Project data		PROCIENCIA
Technologies and R&D and innovation processes developed by consortia targeting value chains and innovative firms in the Climate Strategic Area		Semi-annual	Project data		PROCIENCIA
Tests required by value chains certified by labs		Semi-annual	Project data		PROCIENCIA
Technologies scaled to higher level of technological readiness (TRL) through academic entrepreneurship grants		Semi-annual	Project data		PROCIENCIA
Technologies scaled to higher level of technological readiness (TRL) through academic entrepreneurship grants of which are within the climate Strategic Area		Semi-annual	Project data		PROCIENCIA
Technologies scaled to higher level of technological readiness (TRL) through academic entrepreneurship grants of		Semi-annual	Project data		PROCIENCIA

which are led by women					
Loan proceeds under Components 2 and 3 applied to activities in the climate Strategic Area		Semi-annual	Project data		PROCIENCIA



ANNEX 1: Implementation Arrangements and Support Plan

COUNTRY: Peru

STRENGTHENING THE SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM IN PERU - II

- 1. The implementing agency for this project is the National Scientific Research and Advanced Studies Program (PROCIENCIA).** PROCIENCIA is an agency that depends on the National Science, Technology and Innovation Council (CONCYTEC). As one of the two main operational institutions (along with PROINOVATE) responsible for the implementation of national STI programs, and the one formally in charge of implementing funding dedicated to research in universities and public institutions, PROCIENCIA will be responsible for all administrative, fiduciary, and safeguards functions of the project, as well as the management of the grant and scholarship competitive funds.
- 2. PROCIENCIA was created in July 2021 by absorbing FONDECYT, giving it significant experience in implementing STI programs.** FONDECYT (National Fund for the Development of Science, Technology, and Technological Innovation) was previously the operational arm of the CONCYTEC, with responsibility for managing programs to support basic and applied research, technology transfer, and higher education. FONDECYT was the implementing agency for the World Bank-financed *Strengthening the Science, Technology, and Innovation System in Peru* project (STIS; P156250) initiated in 2018. PROCIENCIA is in the process of absorbing the responsibilities and capabilities of FONDECYT, including implementing the STIS project. (The fusion process is expected to be completed during the first quarter of year 2022 and is a condition of project effectiveness.) This gives FONDECYT significant operational experience in managing STI support programs. The creation of PROCIENCIA responded to the need to optimize the use of public resources and avoid overlapping mandates and functions in the areas of scientific research, human capital formation, technological development, and innovation. PROCIENCIA has a fifteen-year operational time frame after the finalization of the fusion process with FONDECYT.
- 3. CONCYTEC will play a key technical management and oversight role.** CONCYTEC is the agency in charge of the SINACTI (National Science, Technology, and Innovation System) and it falls under the Presidency of the Council of Ministries (PCM). CONCYTEC will be in charge of the technical design of the project interventions, the preparation of the general and specific project operations manuals (including any changes to the manuals), the preparation of the TORs, impact evaluations, and the technical supervision of the implementation of the activities that aim to strengthen SINACTI, as well as any activities that require special technical supervision. In sum, CONCYTEC, as the governing institution in the area of science, technology and innovation, is responsible for the design of all financial instruments under the Project, while PROCIENCIA is responsible for their execution.
- 4. CONCYTEC and PROCIENCIA will collaborate closely throughout project implementation.** PROCIENCIA will convene the technical areas of CONCYTEC to prepare the Annual Operational Plan. This exercise will take into account both the technical and administrative support requirements needed for efficient project implementation. CONCYTEC will have the support of technical and procurement specialists for



the preparation of the TORs and the monitoring and oversight project activities, in coordination with PROCENCIA. At least once a month, meetings will be held between the areas of CONCYTEC and PROCENCIA to monitor the execution of activities in order to take corrective measures, if required. The procurement committees will have advice and support from PROCENCIA and may request the participation of experts as needed.

5. **PROCENCIA will maintain adequate technical, fiduciary, and safeguards staff to implement the project.** Some of these staff are expected to be carried over from those currently implementing the STIS project. Moreover, CONCYTEC and PROCENCIA will benefit from institutional strengthening under components 1 and 4 of the project.
6. **The citizen and beneficiary engagement activities will be undertaken by CONCYTEC and PROCENCIA.** This includes implementing the surveys in Sub-component 1.1.3 and the value chain focused industry-academia dialogues (IVAs) in Sub-component 3.1.1. CONCYTEC will be responsible for the technical design and implementation of the activities, while PROCENCIA will handle the fiduciary functions.

Financial Management

7. **A Financial Management Assessment (FMA) was carried out from September to November 2021 to evaluate the adequacy of FM arrangements for the implementation of the Project.** The FMA recommends a set of mitigating measures to address the main FM challenges. Once the mitigation measures are in place, the proposed FM arrangements will meet the Bank's minimum fiduciary requirements.
8. **Summary of FM and Accountability arrangements.** The FM risk for this Project at this stage is considered **Substantial**. PROCENCIA, once fully operative, will have an independent budgetary line and administrative and fiduciary autonomy. Thus, PROCENCIA (ex-FONDECYT) has previous experience implementing projects financed through WB proceeds. It is expected that PROCENCIA will assign part of its own staff and hire new staff in order to create a dedicated project management team (PMT). The fiduciary aspects of the Project will fall under the responsibility of the Administration Unit (AU) within PROCENCIA. Yet, considering the additional financial work that the project may cause, the PMT of the PROCENCIA will have as minimum FM staff a financial management specialist and a budget and planning specialist, with working experience in WB-financed projects, dedicated to the project. The FM arrangements for this Project will be straightforward; however, components 2 and 3 include transfers of funds (Grants) to several entities (such as universities, public research institutes (PRI) and innovation technology centers (CITEs)) which will require specific financial arrangements. It is important to mention that Peru's central government has sound public FM systems and that the project implemented by the PROCENCIA will benefit from the use of such country systems in the areas of budgeting, flow of funds, accounting, auditing, as well as from the use of public financial information system SIAF.
9. **The FM dimension of the project could be affected by the following main risks and challenges:** (i) PROCENCIA is pending becoming fully operational with respective access to the public financial systems and budget allocation; (ii) delays in budget allocation of resource for the project (both WB and counterpart); (iii) shortage of staff to cope with additional project fiduciary workflow; (iv) lack of

integration of financial information systems to produce timely and accurate financial reports, subproject reports, and justification of expenditures for the Bank; (v) delays in monitoring the justification of expenditures by the grant executing units (such as universities, among other institutions); and (vi) delays in the execution of funds due to slow coordination among the technical and administrative teams of CONCYTEC and PROCIENCIA; and (vii) pending definition of the FM chapter of the MOP including the audit arrangements.

10. **The proposed mitigating measures for managing the Project's FM risks include:** (i) PROCIENCIA should become completely operative (effectiveness condition); (ii) strengthen the AU of PROCIENCIA with a financial management specialist and a budget and planning specialist with experience managing WB-financed projects, recruited under terms of reference satisfactory to the WB, and this is considered a dated covenant; (iii) the Budget and Planning Office shall follow-up and ensure that all the resources of financing are timely and properly allocated after effectiveness (iv) develop an interface among the subproject monitoring system and the financial information system to avoid delays and possible misstatements in the financial reports (dated covenant); (v) complete the operational manual, including the financial management (FM) chapter: financial report formats, processes, procedures, roles, and responsibilities for the administrative team within PROCIENCIA to comply with Bank requirements to manage the Project (effectiveness condition); (vi) complete a specific operational manual (MOEs) for subprojects (grants) with processes and procedures for an adequate monitoring of subproject funds (dated covenant); and (vii) define terms of reference for the external audit, taking into consideration the specific risks identified for this Project. The overall conclusion of the FM assessment is that once the mitigating measures have been put in place and the pending activities concerning staffing, budget, accounting, reporting, and internal controls have been defined, then the proposed FM arrangements will meet the World Bank's minimum fiduciary requirements.

Financial management arrangements

11. **Staffing and organizational arrangements.** As indicated by PROCIENCIA, FM functions for the Project will be carried out by its UA and Budget and Planning Office, including the following positions: Chief Administrator, Accountant, Treasurer, and Budget Officer. An additional FM specialist shall be hired to strengthen the UA and the project team to support the Project's FM requirements. The FM specialist shall be considered key staff and shall be hired no later than 30 days after the Effectiveness date.
12. **Accounting and information systems.** PROCIENCIA, once fully operational, must comply with the Peruvian budget and public financial management laws, including the use of *Sistema Integrado de Administración Financiera* (SIAF) and its general chart of accounts. In addition, there are other two systems that will support the operation that are: (i) *Sistema Integrado de Gestión* (SIG) for the monitoring of subprojects, and (ii) *Módulo de Ejecución de Proyectos* (SYSMEP) for issuing the financial statements. Nevertheless, these systems are not fully integrated; therefore, it is necessary to develop an interface among all systems before the submission to the WB of the first unaudited interim financial report (UIFR). This will help in issuing financial reports and preparing statements of expenditures (SOEs) in US dollars according to the components/categories of the Project.
13. **Financial reporting.** PROCIENCIA will prepare the IFRs using the SIGMED system with information

downloaded from SIAF. These reports will include loan proceeds and local counterpart funds. The IFRs will be prepared in US dollars and will be submitted to the Bank by the PIU on a semi-annual basis, no later than 45 days after the end of each calendar semester. The format and content of the IFRs⁸² will be included in the POM. On an annual basis, PROCIENCIA will also prepare financial statements for the Project in accordance with the formats agreed in the POM. These will include cumulative figures for the beginning and end of the year, along with notes to the financial statements. These financial statements will be audited in accordance with the Bank's requirements and submitted to the Bank within six months of the end of the government's fiscal year (December 31). Working papers for the preparation of the semi-annual and annual financial statements should be kept by the PIU and should be made easily accessible to WB supervision missions and to external auditors.

14. **Grants - Sub project and Scholarships.** To implement the subproject and scholarships, a subproject-agreement / scholarship agreement will be signed between the beneficiary entity or student and the PIU. The specific subproject manual (MOE), for each type of Grant, detailing administrative processes, formats, and simplified reports will be approved by the Bank.
15. **Internal Audit.** PROCIENCIA is under the scope of the Organic Law of the National System of Control and the General Comptroller of the Republic (*Ley Orgánica del Sistema Nacional de Control y de la Contraloría General de la República, CGR*). As such, under CONCYTEC's organizational structure includes an Internal Control Office (*Órgano de Control Institucional, OCI*) that is responsible for the oversight of all operations including the PIU PROCIENCIA. In this capacity, these OCI will play a role in safeguarding the Project's internal control. Whenever possible, the team will use their reports as part of the Project's regular supervision and monitoring activities.
16. **Oversight and Supervision Arrangements.** On a preliminary basis, the FM team plans to perform two supervision missions per year to support the project implementation, while also reviewing the annual audit reports and the semester IFRs.
17. **External Audit.** Annual audit reports on financial statements for the Project, including management letters, should be submitted to the Bank within six months of the end of the Borrower's fiscal year (December 31). The audit should be conducted by an independent audit firm acceptable to the WB and under terms of reference approved by the WB. The selection of the audit firm should be performed through the CGR. The cost of the external audit can be financed out of loan proceeds. The scope of the audit will be defined by the PIU in agreement with the Bank, based on project-specific requirements. It will also respond to identified risks as appropriate, including a management letter and a review of compliance with agreed processes and procedures. Audit requirements include:

Audit type	Due date
Project financial statements	June 30
Special Opinion: Subproject financial reports	June 30

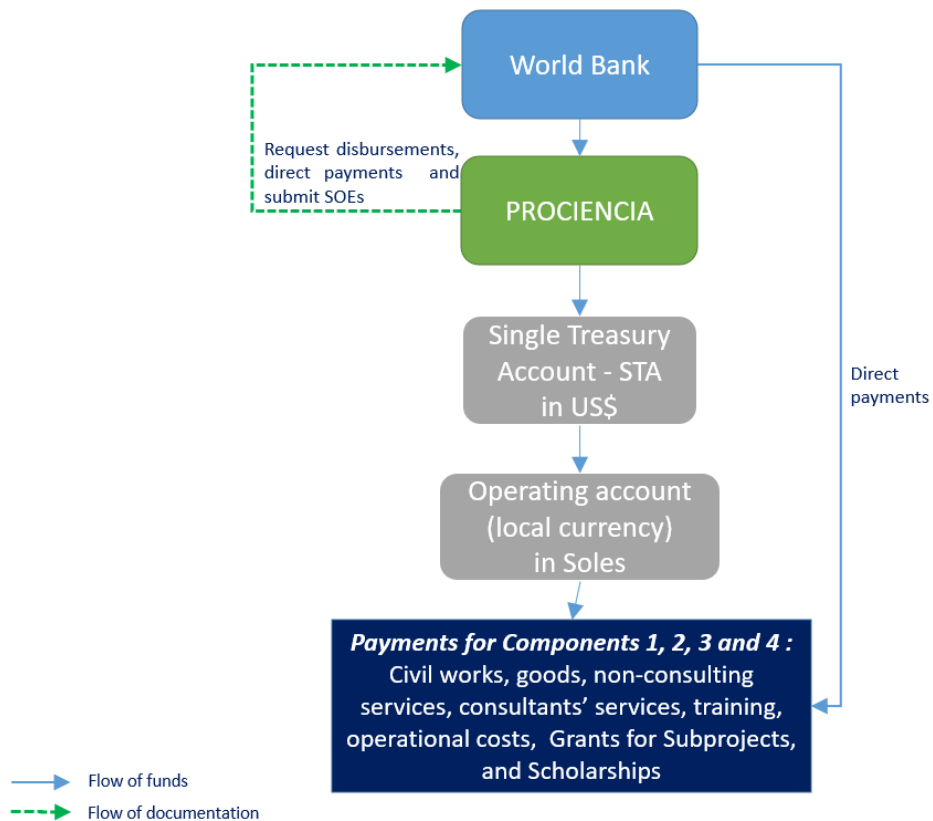
⁸² These IFRs will include: (i) a statement of sources and uses of funds, including reconciling items (as needed) and cash balances, with expenditures classified by project component /categories; (ii) a statement of the cumulative funds, reporting the current semester and the accumulated operations by component of ongoing plans and footnotes explaining the important variances, (iii) statement of projects containing the number of contracts, amounts disbursed, amounts justified and pending of justification balances, and (iv) notes to the financial statements.



18. **Funds Flow and Disbursement Arrangements.** Bank loan proceeds will follow the Bank’s disbursement policies and procedures as described in the DFIL. The Bank and the Borrower have agreed to use the Single Treasury Account⁸³ (STA) as a disbursement mechanism for the project and, hence, advances to the designated account will be made to the STA. The STA for the use of loan resources is in place in Peru according to the Legislative Decree No 1441. Funds of the loan will be identified with a segregated code or sub-account of the STA. The POM will include specific procedures that will allow the project to operate the STA. The Bank will disburse Loan proceeds using one of following three methods: (i) advance method: under the STA with a flexible ceiling based on quarterly forecast, (ii) direct payment: the minimum application size for direct payment requests would be US\$1,000,000; and (iii) reimbursement: the minimum application size for reimbursement method would be US\$1,000,000.

The Project’s flow of funds is presented in the following flow chart:

Figure 14 Funds Flow and Disbursement Arrangements



19. Under the advance method and for control purposes, the PMT of PROCENCIA will be responsible for presenting disbursement applications to the Bank as well as presenting their justifications for expenditures (through SOE). Funds deposited into the STA as advances will follow the Bank’s

⁸³ Financial Institution for the Single Treasury Account: Banco Central de Reserva del Peru (BCR).



disbursement policies and procedures, which will be described in the DFIL. For processing payments in local currency, PROCENCIA will use a code (subaccount) assigned by MEF to pay consultants, suppliers, and beneficiaries' bank accounts. The specific protocols and applicable internal control arrangements for the payment processes and procedures will be reflected in the POM and governed by the corresponding inter-PROCENCIA institutional agreements.

- 20. **Withdrawal Conditions.** Retroactive Financing for payments made prior to the Signature Date of the Loan Agreement, except that withdrawals up to an aggregate amount not to exceed US\$20,000,000 may be made for payments under category 3 made prior to this date but on or after May 19, 2021 (but in no case more than one year prior to the Signature Date), for Eligible Expenditures.
- 21. **Grants and Scholarships.** Under Categories 1 and 2, PROCENCIA will submit for Bank approval the specific operational manual (MOE) for each type of subproject or scholarship as part of the Project Operational Manual. Amounts disbursed to subproject beneficiaries will be recorded as expenditures and justified in a Customized Statement of Expenditures (SOEs). Disbursement to subprojects will be monitored through the tailor-made monitoring information system SYG. The beneficiaries will be responsible for the execution of subprojects in accordance with procedures established in the subproject agreements and respective MOEs.
- 22. **Counterpart funds, documentation requirements, and disbursement deadline date.** The PIU will manage the counterpart funds for the Project using the STA established by the government. To process payments, funds for the Project will be identified with a specific project code and account in SIAF. Supporting documentation for expenditures under the disbursement methods authorized for the Project should be in accordance with the provisions established under the Disbursements and Financial Information Letter (DFIL). The Disbursement Deadline Date is four months after the Closing Date specified in the Loan Agreement. Any changes to this date will be notified by the WB.

Table 1: Table of Loan Proceeds

Category	Amount of the Loan Allocated (expressed in US\$)	Percentage of Expenditures to be financed (inclusive of Taxes)
(1) Grants under Parts 1.1.5, 2.1.1, 2.2.1, 2.2.2, and 3.2	60,868,260	100%
(2) Scholarships under Part 2.1.2	20,253,600	100%
(3) Goods, non-consulting services, consulting services (including audits), Operating Costs, and Training under Parts 1, 2, 3 and 4 (but excluding Grants and Scholarships)	18,878,140	100%
TOTAL AMOUNT	100,000,000	

Table 2: Expected Disbursements (US\$, Millions)

WB Fiscal Year	2022	2023	2024	2025	2026	2027	2028
Annual	1	9	20	20	20	20	10
Cumulative	1	10	30	50	70	90	100

Procurement

23. **Procurement will be implemented according to the World Bank's Procurement Regulations for IPF Borrowers** dated November 2020, for the supply of goods, non-consulting, and consulting services under the project and the provisions stipulated in the Loan Agreement. Procurement for goods, consultant services and non-consulting services will be implemented based on the Mandatory Procurement Prior Review Thresholds detailed in Annex I of the WB's Procurement Procedures. The World Bank's Standard Procurement Documents will govern the procurement of World Bank-financed Open International Competitive Procurement. For procurement involving National Open Competitive Procurement and other methods, the documents will be agreed with the World Bank.
24. **Procurement capacity assessment: The World Bank carried out from September to November 2021 a procurement capacity assessment of the executing agency, PROCENCIA, to implement procurement activities.** PROCENCIA will be the executing entity for this operation with the input of CONCYTEC's technical teams. PROCENCIA, a recently created institution (through Supreme Decree of March 2021) absorbs FONDECYT by merger, and the transition from the current legal structure (FONDECYT) to the new one (PROCENCIA) is currently underway. The assessment concluded that PROCENCIA (ex-FONDECYT) has increased its experience in procurement under World Bank Guidelines over the past 3 years, running the current Bank financed project (phase I). However, it has done so via a complex management structure with CONCYTEC. For the implementation of this new project, PROCENCIA will need to hire and maintain throughout the project execution, professional(s) qualified with enough experience in procurement under World Bank's Procurement Guidelines and/or Regulations (at least two procurement specialists with a support team). The professional(s) should be fully dedicated to the project and adequately respond to procurement activities at the central and sub-project levels. A mitigation plan proposed to strengthen the procurement capacity of PROCENCIA includes the following recommendations:

Table 3: Mitigation actions propose for the Procurement-relate Risks

Risks - Areas for Improvement	Mitigation Actions	Responsible	Status / When
Procurement planning Lack of planning or poor planning can cause delays in project execution.	The executing agency with the Bank's support has prepared a PPSD and a Procurement Plan.	PROCENCIA	Completed
	Include the Procurement Plan in the WB's STEP system.	PROCENCIA	After effectiveness and before starting the first procurement process
	Keep the PPSD and the Procurement Plan updated in STEP to reflect the current and real Project execution.	PROCENCIA	During project implementation.



<p>Files and documentation management: Incomplete procurement records / files, lack of available information for audits and/or post-reviews.</p>	<p>Guarantee the proper records management of procurement processes and contract administration. This includes keeping the information properly and timely filed to facilitate monitoring and audits. In the POM, a full and detailed description of how the procurement records will be managed under the project will be included.</p>	<p>PROCIENCIA</p>	<p>Immediately after effectiveness</p>
<p>Subprojects: Non-compliance of procurement procedures due to lack of Eligible Grantee experience (universities, Public Research Institutes, among others). Lack of proper procurement monitoring and support from PROCIENCIA to Eligible Grantee during subprojects implementation</p>	<p>PROCIENCIA will monitor and support the procurement processes by the Eligible Grantees. The specific subproject manuals for each type of Grant will specify the applicable procurement arrangements and procedures. As needed, a training program will be developed on the application of the procurement procedures, to be provided regularly to the Eligible Grantees.</p>	<p>PROCIENCIA</p>	<p>During project implementation</p>

25. **Procurement arrangements.** PROCIENCIA, with the Bank's support, has prepared a PPSD that establishes the best procurement arrangements to ensure the delivery of value for money while efficiently achieving the agreed PDO. The PPSD concluded that Project's resources will be concentrated around 25 percent on procurable expenses of consulting services, goods and non-consulting services directly performed by PROCIENCIA, and 75 percent for subprojects awarded through Grants (open and competitive calls) whose procurement activities will be carried out by each Eligible Grantees of each subprojects' implementation. A summary of PPSD, including recommended procurement approach for higher value contracts, is detailed in Table 2.

26. **The PPSD focuses on one of the highest-risk, highest-value contracts,** namely, procurement of technological equipment for the digitization of CONCYTEC (licenses and hardware). The analysis shows some alternatives in terms of number and characteristics of possible bidders, based on which, the best approach is to carry out an open international competitive process through a Request for Bids. The process has some complexity but with standard technical specifications, so the preparation of the bids will not require much time or effort for the eventual bidders, nor the evaluation of those bids for the Evaluation Committee.

27. **The procurement arrangements for other activities that are expected to be carried out are detailed in the PPSD and the procurement plan, as follows:**

- **Consulting services.** The market approach for specific services in innovation, science, and technology issues (IVAs competitiveness program, technical assistance, programs and platforms implementation and other studies/analyses) will be an open competition in the international market. The market approach for other consulting services planned will be open competition in the national market. QCBS, QBS, LCS, CQS or direct selection, would be the selection methods, considering the nature and scope of the services.

- **Individual consultants.** Individual consultants will be selected in accordance with the provision of paragraphs 7.34 to 7.39 of the Procurement Regulations.
 - **Goods and Non-consulting services.** The Project will finance the procurement of cloud services, survey applications and other services, including subscription for access to scientific texts. According to the PPSD, the open national competitive bidding approach will be applied except for the subscription service that will be an open international competitive bidding process. The national approach is supported by the availability of bidders in the local market.
28. **Procurement Plan.** In accordance with paragraph 5.9 of the Procurement Regulations, the World Bank's Systematic Tracking and Exchanges in Procurement system will be used to prepare, clear, and update the Project Procurement Plan and conduct all procurement transactions for the project, as necessary. The initial Procurement Plan was prepared by PROCENCIA in accordance with the results provided by the PPSD and agreed with the World Bank on November 19, 2021.
29. **Grants for subprojects.** Achieving the subprojects objectives will require financing both procurable (goods, NCS, and consulting services) and non-procurable items (such as scholarships and stipends). Procurement of goods, non-consulting services (NCS) and consulting services will be carried out considering the eligible expenses and the specific procurement arrangements in accordance with the WB Procurement Regulations applicable to the Project that will be set forth in the Project Operational Manual and specific manuals for each Grant and type of subproject, under terms and conditions approved by the Bank, and must include at least: 1. Procurement capacity assessment methodology of Eligible Grantees; 2. Procurement methods to be applied; 3. Annexes - simplified procurement documents (procurement plan, request for quotations, model contracts / purchase orders, fraud and corruption annex, etc.); 4. Roles and responsibilities of all parties involved in procurement activities (PROCENCIA, Eligible Grantees, etc.); 5. Procurement supervision arrangements; 6. Audit arrangements; 7. Documentation that the Eligible Grantees must keep and submit as part of the regular reporting process; and 8. The relevant model form of Grant Agreement (in the case of a Sub-Project) or Scholarship Agreement and Student Agreement (in the case of a Scholarship). Under subprojects, Eligible Grantees would decide what investments to make according to their business plans and competitively selected proposals. The grant application will contain a business plan including a simplified procurement plan with a list of the goods and services to be procured and their estimated cost.
30. **Frequency of Procurement Supervision.** In addition to prior review supervision to be carried out by the WB office, annual supervision missions will be carried out to visit the field and conduct post review of procurement actions.

Table 4: Summary of PPSD

Description	Estimated Cost (US\$, thousands)	Review	Market Approach	Procurement Method
Consulting Firms				
Consulting services to implement the Competitiveness Strengthening Program (IVAs) - Round 2	1,700	Prior	International - open	QCBS
Consulting service for software development of competitive funds management	1,503	Prior	International - open	QCBS

Consulting Service for the improvement and strengthening of Technology Transfer Offices capacities	1,500	Prior	International - open	QCBS
Consulting services for the implementation of technology transfer strengthening program in SINACYT institutions	1,200	Prior	International - open	QCBS
Goods				
Procurement of Licenses and Hardware	2,106	Prior	International - open	RFB

Monitoring and evaluation

31. The project will build on existing M&E systems in PROCENCIA, and Component 1 will support the development and enhancement of M&E systems. Several results will be disaggregated by gender and climate financing as indicated in the results framework. PROCENCIA will prepare semiannual reports with data for the results framework, to be reviewed and discussed with the World Bank. The results framework data will be captured in Implementation Status and Results reports that the World Bank team will prepare periodically. Implementation support provided by the World Bank team will also enhance results M&E.

Implementation Support Plan

32. The implementation of the project will be supported by a team of World Bank experts, including Task Team Leaders from the Finance, Competitiveness and Innovation (FCI) and Education Global Practices, as well as procurement, financial management, and safeguards specialists. Local and international consultants are also expected to provide support and expertise on an as-needed basis. Support will come from a mix of staff and consultants from the World Bank headquarters, Peru country office, and elsewhere to ensure an appropriate balance of local and regional knowledge, responsiveness, and global expertise.

Table 5: Implementation Support Plan

Time	Focus	Skills Needed
First 12 months	Fine-tuning and launching the competitive grant and scholarship instruments and key capacity building procurement processes	Full team (see table below)
13-66 months	Implementing the grant and scholarship instruments and technical assistance activities	Full team (see table below)

Table 6: Skills Mix Required (Annual)

Skills Needed	Number of Staff Weeks	Number of Trips Per Year
Task Team Leader (DC)	10	3
Co-TTL(s) (DC)	8	2
Procurement specialist (Lima)	3	0



Financial management specialist (Lima)	2	0
Environmental safeguards specialist (Lima)	2	Field trips as required
Social safeguards specialist (Lima)	2	Field trips as required
Senior innovation advisors (STCs)	2	0

ANNEX 2: Economic Analysis

COUNTRY: Peru

STRENGTHENING THE SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM IN PERU - II

Rationale for Public Intervention

- 1. Peru has been one of the fastest growing countries in LAC, though it remains highly dependent on a small number of extractive activities.** Economic growth has averaged 5.2 percent in the last 15 years prior to the COVID-19 crisis. Growth has been, however, reliant on increasing global commodity prices. Extractive industries have grown by 50 percent as share of GDP over the past 30 years, posing a vulnerability in the long-term growth prospects. This underscores the country's need to increase firm productivity and diversify its exports. Among other thing, this requires overcoming significant binding constraints such as the low capacity of Peru's Science, Technology, and Innovation (STI) system.
- 2. The nature of the innovation process motivates the intervention of governments in the area of STI.** The high uncertainty associated with innovation investment returns and the fact that innovation produces intangible assets make innovation more difficult to finance with purely private resources. A significant share of the knowledge generated by the innovation process is tacit, embedded in the human capital of firms' employees and in its organizational capital and it is difficult to separate from the other assets in the firm. Banks and other external sources of funding do not typically accept intangible assets as collateral. The ability to collateralize such assets is usually limited to codified and registered knowledge, as in the case of patents, though there are ongoing efforts to create more liquid intellectual property (IP) markets. Moreover, the returns to innovation are uncertain, in the sense that it is not possible to assess the probability of success and failure, hampering the ability to estimate the expected return to the investment. Innovation usually carries two types of uncertainty: technological uncertainty (whether the product can be successfully developed) and market uncertainty (whether the new product will be in demand), although the proportion of each varies by industry sector.
- 3. Access to finance for innovative projects depends on different factors.** These include the nature of the innovation activity and the innovator's industry sector, which may entail different levels of uncertainty or diverse sizes of financing requirements. Another factor that affects financial access is the stage at which the innovation processes are in, with those in early stages presenting more difficulty to raise capital as these tend to present higher uncertainty and intangibility. Additionally, characteristics of the innovating firm also come into play, as smaller and younger firms tend to face more obstacles because their product may be immature, may lack assets for collateral, and the management team may be inexperienced.
- 4. The existence of market failures justifies government intervention in STI.** This is because market failures lead to less financing for innovation than would be socially desirable. The limited information that is available about the likelihood of success of a particular innovation project tends to be asymmetrically distributed. Banks that intend to lend to innovators face an adverse selection problem, as an interest rate set based on the (uncertain) average risk of a pool of projects would drive low-risk borrowers out of the market, increasing the credit risk of the remaining pool. Banks also face moral hazard concerns, as

the innovative nature of the projects limits their ability to monitor the activities that are undertaken. Hence, the incentives of the innovator once the loan is granted are tilted towards taking higher risks than socially optimal. Moreover, besides asymmetric information, innovators have positive spillover effects, or externalities, on the economy that the innovator may not be able to turn these into a profit for themselves. While efforts are made to capture part of the benefits of a particular innovation as much as possible (e.g., through IP, secrecy or first-mover advantage), firms are often not able to fully internalize the returns. Given that private returns of the innovators will be lower than the full account of social returns of the activity, the private investment will be below the social optimum, making the case for government support to the innovation process. Finally, innovation activity thrives in the context of networks of different actors such as entrepreneurs, suppliers, lenders, partners, and customers, which in turn operate in a given set of underlying infrastructure and institutions. Coordination failures may curtail the participation of critical stakeholders, hampering local development. This lack of coordination provides a rationale for public policies to promote innovation through a cluster-based approach including infrastructure and knowledge-based investments, networking activities and training, which would jump-start knowledge spillovers among actors in the clusters, boosting their productivity.

5. **In the case of Peru, the lion's share of local R&D investment is in basic and applied science, and only 7 percent is in technological development.** This points to market failures constraining private sector investment, such as low appropriability or concentrated market power in some sectors that limits innovation-driven competition. Most importantly, weak governance and lack of public-private dialogue lead to low relevance of much of the produced research to market demand, as well as a lack of alignment with the country's priority developmental challenges. Low relevance of research in turn leads to low interest by industries to collaborate with academia, resulting in a self-perpetuating cycle.

Cost-Benefit Analysis

Costs at Market Prices & Social Cost of the Project

6. This section presents the analysis of the costs and benefits of the project for each of the four components. The information about costs has been provided by CONCYTEC and PROCIENCIA.⁸⁴ The estimated total cost associated to this project is US\$125 million, equivalent to PEN 462.5 million assuming an exchange rate of 3.7 sol per U.S. dollar.⁸⁵
7. The Feasibility Study of the Project approved by the government also provides the associated social costs, which have been calculated according to the evaluation parameters of the *Sistema Nacional de Inversión Pública* (National Public Investment System, SNIP). Given that the services that will be provided under this project fall in the category of non-tradable, their price is determined by the domestic demand and supply. Thus, the social price associated with the services is the market price net of taxes (for example, general sales tax, which has a rate of 18 percent⁸⁶).

⁸⁴ A complete economic analysis of the project is included in the feasibility study approved in Peru's public investment system (Estudio de Preinversión a Nivel Perfil "Mejoramiento y ampliación de los servicios de CTI para Fortalecer el Sistema Nacional de Ciencia, Tecnología e Innovación", June 2021) and it is summarized in this Annex.

⁸⁵ The exchange rate is based on the market expectations for 2023, as per the Survey of Macroeconomic Expectations of the Central Reserve Bank of Peru.

⁸⁶ The difference between the market and the social price of services is presented in Table 7 as an adjustment factor. In the case



(a) **Costs of Component 1.** (US\$17 million) Table 7 shows the costs associated with Component 1, which aims to strengthen the effectiveness of the NIS governance, institutions, and bolster innovation in Peru. The estimated costs are divided in two subcomponents: 1.1) Strengthening CONCYTEC and digitalizing the NIS (US\$12.9 million); 1.2) Decentralization of NIS and equal access to scientific information (US\$4.1 million). Once the effect of taxes is removed, the social cost associated to Component 1 totals US\$14.5 million (PEN53.6 million).

Table 7. Estimated costs for Component 1 - Strengthening SINACTI's institutions and governance (US\$)

Subcomponents and activities	Market Value	Factor	Social Cost
1.1. Strengthening of SINACTI	12,917,673		11,312,944
1.1.1. Strengthening the institutional management capacities of CONCYTEC to strengthen its role as the governing body of SINACTI	8,000,000		6,779,661
<i>Digital transformation of CONCYTEC</i>	2,000,000	0.85	1,694,915
<i>PeruCRIS - Stage 2</i>	2,000,000	0.85	1,694,915
<i>Concurrent funds management platform in PROCENCIA</i>	4,000,000	0.85	3,389,831
1.1.2. Technical assistance for SINEACE & SUNEDU to develop tools to enable the generation of quality indicators in STI postgraduate programs	755,000		639,831
<i>Diagnostic of quality of post-graduate programs</i>	135,000	0.85	114,407
<i>State of the art and international benchmark for graduate programs</i>	135,000	0.85	114,407
<i>Roadmap and definition of indicator systems</i>	350,000	0.85	296,610
<i>Development of proposed regulatory arrangements</i>	135,000	0.85	114,407
1.1.3. National program of STI indicators	1,600,000		1,355,932
<i>National census program</i>	300,000	0.85	254,237
<i>National survey program</i>	1,000,000	0.85	847,458
<i>Study fund</i>	300,000	0.85	254,237
1.1.4. Self-assessment for IPIs with external support	1,250,000		1,231,481
<i>Consultancy in normative arrangements for IPIs and self-assessment design</i>	200,000	0.93	185,185
<i>Self-diagnosis of IPIs accompanied by an international institution</i>	1,000,000	1.00	1,000,000
<i>Assistants for the development of the project</i>	50,000	0.93	46,296
1.1.5. Research Networks	1,312,673		1,306,040
<i>Financing of research networks on strategic issues</i>	1,222,000	1.00	1,222,000
<i>Assistants for the development of the project</i>	90,763	0.93	84,040
1.2. STI decentralization and equitable access to scientific information	4,100,000		3,161,669
1.2.1 Access to full-text of international scientific literature	4,100,000		3,161,669
<i>Institutional arrangement design to develop sustainability network</i>	100,000	0.85	84,746
<i>Subscription to full-text information resources</i>	4,000,000	0.77	3,076,923
Component 1 Total	17,017,673		14,474,613

of services provided by firms, the general sales tax rate is 18 percent, so the adjustment factor is 0.85 (that is, 1 / 1.18). For professional services provided by individuals, the rate is 7 percent and hence the adjustment factor 0.93 (that is, 1 / 1.07). The subscription to full-text information resources is taxed at 30 percent, so the adjustment factor is 0.77. Finally, competitions involve a non-reimbursable transfer of funds, so the adjustment factor used is 1.

- (b) **Costs of Component 2.** (US\$74.8 million) Table 8 shows the costs associated with Component 2, which aims to strengthen the capacity of the NIS by improving the quality, quantity and relevance of training at the doctoral level and research products in strategic and general science areas. The estimated costs are divided in two subcomponents: 2.1) supporting the creation of new, high quality doctoral programs and the strengthening of existing ones; providing direct scholarships for doctoral students and young researchers at selected programs (US\$38.7 million); and 2.2) MSTQ grants for laboratories and support for projects in strategic priority areas (US\$36 million). Once the effect of taxes is removed, the social cost associated to Component 2 totals US\$74.5 million (PEN275.5 million).

Table 8. Estimated costs for Component 2 - Capacity development for knowledge generation in strategic sectors and regions - US\$

Subcomponents and activities	Market Value	Factor	Social Cost
2.1 Institutional partnership for the creation and strengthening of high-quality doctoral programs and STI human capital formation	38,743,150		38,575,559
2.1.1 Institutional partnership for the development of capacities in research science and technology	17,779,630		17,618,226
<i>Financing to attract researchers to improve research capacities in STI research institutions</i>	6,600,000	1.00	6,600,000
<i>Financing of institutional partnership for the development of capacities in science and technology research</i>	10,060,000	1.00	10,060,000
<i>Assistants for the development of the project</i>	119,630	0.93	110,768
<i>Supervision and support of doctoral programs</i>	500,000	0.85	423,729
<i>Mid-term and final evaluation</i>	500,000	0.85	423,729
2.1.2 Human capital development programs in STI	20,963,520		20,957,333
<i>Scholarships for students / 290 scholarship recipients</i>	20,880,000	1.00	20,880,000
<i>Assistants for the development of the project</i>	83,520	0.93	77,333
2.2. MSTQ grants for laboratories and support for projects in strategic priority areas	36,034,000		35,887,664
2.2.1 Strengthening of laboratories	19,150,000		19,009,886
<i>Competition for financing laboratory equipment</i>	18,000,000	1.00	18,000,000
<i>Arrangements to implement the competition</i>	450,000	0.93	416,666
<i>Capacity building in laboratory management and operation</i>	700,000	0.85	593,220
2.2.2. Projects for the needs of strategic sectors	16,884,000		16,877,778
<i>Competition for the financing of projects for needs of strategic areas on challenges</i>	8,100,000	1.00	8,100,000
<i>Financing of research projects to improve research capacities in STI research institutions</i>	8,700,000	1.00	8,700,000
<i>Competition implementation arrangements</i>	84,000	0.93	77,778
Component 2 Total	74,777,150		74,463,223

- (c) **Costs of Component 3.** (US\$23.7 million) Table 9. shows the costs associated with Component 3, which aims to strengthen the linkages between R&D outputs and market demand. The estimated



costs are divided in two subcomponents: 3.1) Strengthening industry-academia linkages and enabling feedback loops that shape R&D to be more relevant to users and building the institutional capacity needed to facilitate technology transfer (US\$5.7 million); and 3.2) financing three grant windows including demand-driven contract research primarily identified through IVAs, Academic Entrepreneurship in science-based R&D at advanced stages of maturity as well as R&D projects that have a high the potential to become Technology-Based Companies (EBT) (US\$18.1 million). Once the effect of taxes is removed, the social cost associated to Component 3 totals US\$23.2 million (PEN85.8 million).

Table 9. Estimated costs for Component 3 - Strengthened Industry-academia linkages to accelerate technology transfers and innovations - US\$⁸⁷

Subcomponents and activities	Market Value	Factor	Social Cost
3.1. Establish demand and supply of research and development to promote linkage between academia and industry	5,652,027		5,183,138
3.1.1. Aligning demand and supply of R&D and promoting industry-academia linkages	1,800,000		1,525,424
<i>Competitiveness Reinforcement Initiatives - Round 2</i>	1,700,000	0.85	1,440,678
<i>Logistics services for the implementation of IVAs</i>	100,000	0.85	84,746
3.1.2. Building the institutional capacity needed to facilitate technology transfer	3,852,027		3,657,715
<i>SINACTI technology transfer strengthening program</i>	1,200,000	0.85	1,016,949
<i>Improvement of Technology Transfer Offices (OTTs)</i>	1,500,000	1.00	1,500,000
<i>Assistants for the development of the project</i>	75,000	0.93	69,444
<i>Implementation of an OTT Hub</i>	1,000,000	1.00	1,000,000
<i>Assistants for the development of the project</i>	50,000	0.93	46,296
<i>Creation of the national OTT network on the Vinculate platform and promotion of a culture favorable to collaboration</i>	27,027	0.93	25,025
3.2. Strengthening Industry-academia linkages to accelerate technology transfer	18,058,750		18,015,571
3.2.1. Development of necessary technologies for value chains	12,831,250		12,797,516
<i>Consulting for the implementation of the instrument</i>	70,000	0.85	59,322
<i>Development of technologies for value chains</i>	6,750,000	1.00	6,750,000
<i>Certification of analyzes identified for value chains</i>	3,200,000	1.00	3,200,000
<i>Assistants for the development of the project</i>	248,750	0.93	230,324
<i>Laboratory accreditation</i>	2,500,000	1.00	2,500,000
<i>Assistants for the development of the project</i>	62,500	0.93	57,870
3.2.2. Scaling-up technology development & innovation-based entrepreneurship	5,227,500		5,218,055
<i>Consulting for the implementation of the instrument</i>	1,500,000	1.00	1,500,000
<i>Development of technologies for value chains</i>	3,600,000	1.00	3,600,000
<i>Assistants for the development of the project</i>	127,500	0.93	118,055

⁸⁷ The costs for the citizen/beneficiary engagement activities, i.e., the Competitiveness Reinforcement Initiatives / IVAs, are shown in Sub-component 3.1.1.

Component 3 Total	23,710,777		23,198,710
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- (d) **Component 4.** (US\$9.5 million) Table 10 presents the cost of the project management, and monitoring & evaluation. Once the effect of taxes is removed, the social cost associated to Component 3 totals US\$8.7 million (PEN32.1 million).

Table 10. Estimated costs for Component 4 - Project management, monitoring & evaluation - US\$

Subcomponents	Market Value	Factor	Social Cost
A. Staff	6,384,000	0.93	5,911,112
B. Equipment	740,000	0.85	627,119
C. Studies and Consultancies	1,470,400	0.93	1,361,482
D. General Expenses	900,000	0.85	762,712
Component 4 Total	9,494,400		8,662,425

8. To summarize, the expected total social cost of the project is US\$120.8 million. Table 11 presents a summary per component.

Table 11. Summary of Estimated Costs Per Component – US\$

Project Component	Market Value	Factor	Social Cost
Component 1	17,017,673	0.85	14,474,613
Component 2	74,777,150	1.00	74,463,223
Component 3	23,710,777	0.98	23,198,710
Component 4	9,494,400	0.91	8,662,425
Total cost of the Project	125,000,000		120,798,971

Private and Social Benefits of the Project

9. **The Project has large potential private and social benefits.** Innovation is the driving force of the creative destruction process needed to spur economic dynamism and transformation (Schumpeter, 1942).⁸⁸ Product innovation stimulates employment, as the compensation effect via increased demand dominates the displacement effect of reduced labor requirements (Hou et al., 2018).⁸⁹ Innovation is a key element for a successful integration of SMEs in GVCs, which in turn is an enabler of productivity growth at the firm level. It can ultimately contribute to poverty reduction by fostering productivity, real wages and employment growth, prompting an increase the income of the vulnerable households.

⁸⁸ Schumpeter, J. (1942). "Capitalism, Socialism, and Democracy" Harper and Row (reprinted 1980), New York.

⁸⁹ Hou, J., C. Huang, G. Licht, J. Mairesse, P. Mohnen, B. Mulkay, B. Peters, Y. Wu, Y. Zhao, F. Zhen. (2019) "Does innovation stimulate employment? Evidence from China, France, Germany, and The Netherlands" Industrial and Corporate Change, Volume 28, Issue 1, February 2019, Pages 109–121.



10. **The assessment of private and social benefits is related to Components 2 and 3.** The approach is aligned with the Feasibility Study of the Project approved by the government, with some minor caveats for adjustments introduced by the WB team (described in paragraph 18 below). Due to the lack of a commonly accepted methodology for the economic analysis of Component 1, its analysis is based on cost effectiveness. Nonetheless, there is evidence of this component's benefits to society. Component 1 will, inter alia, update the institutional management instruments, improve interoperability between financing programs, data analysis and data quality management, as well as monitoring and evaluation and public expenditure models. As such, it will be an effective tool to make the Government accountable for the use of public resources, while it will also help identify better ways to design future programs to make them more effective. There are no identified alternative lower-cost methods to improving SINACTI's institutional capacity than supporting the GoP to implement reforms and build the capacity of the relevant agencies. It should be noted that the overall economic analysis follows the conservative approach of including the Project costs associated with Component 1 and those for Project management, monitoring, and implementation (Component 4) without any estimated direct benefits being included in the calculations.
11. **The SNIP Feasibility Study lays out the private and social benefits of the Project in four stages.** In a first stage, the Project invests in the establishment of 8 institutional partnerships for the development of research capacities, including, among others, scholarships for 290 full-time doctoral students. For the candidates to graduate, they will be required to contribute to the state of the art which will be in effect an increase in R&D. In a second stage, Project investments are directed to the strengthening of 26 research networks, 6 laboratories, and the implementation of 6 research projects that solve specific challenges in strategic areas. This will further contribute to the increase in R&D. In a third stage, the knowledge generated previously is transferred to specific applications by firms. Instruments used for this stage include the Technology Transfer Offices, which will be strengthened in Component 3. Similarly, knowledge generated previously could turn into innovations through the development of scaling-up technology by "Technology-Based Entrepreneurs" (EBTs, using the Spanish acronym). In its final stage, the Project will conduct Competitiveness Reinforcement Initiatives for Productive Innovation (IVAI), which would allow to solve bottlenecks in productivity in certain sectors, through the development of R&D projects and certification of certain specific tests in the industry.

Private Benefits of Subcomponent 2.1.2 - 290 doctoral grants

12. The investment in human capital has benefits that are reflected in the increased productivity that researchers exhibit after their doctoral studies. Hence, under standard assumptions about the researcher's remuneration, their increased productivity would be fully captured by the increase in their salary after completing their graduate education. Based on the assumption of a job horizon of 25 years, a discount rate of 8 percent and a success rate of 75 percent, the present value associated with this subcomponent is US\$60.6 million (Table 12). Alternatively, if a 15-year job horizon is considered instead, the net present value (NPV) falls to US\$ 48.6 million. This approach does not consider several associated externalities which are significantly more difficult to quantify.

Table 12. Private Benefits of Subcomponent 2.1.2

Masters degree's holder annual est.salary	USD 24,509
PhD's holder annual est. salary	USD 50,595
Estimated annual increase	USD 26,085
Number of interns	290
Years of research	25
Discount rate	8%
NPV of the Increased Benefits in the availability of Human Capital for I+D+i	USD 80,752,201
Success rate	75%
Expected NPV of the Increased Benefits in the Availability Of Human Capital for I+D+i	USD 60,564,151

Private and Social Benefits of Subcomponent 3.2.1 - Development of 90 technologies; 50 labs accredited by INACAL

13. The estimation of the benefits associated with this subcomponent is based on the methodology proposed by Mansfield et al. (1977)⁹⁰ that takes into consideration both private and social benefits of innovating. Under this framework, private benefits account for the additional gains obtained in terms of sales by the innovating firm, as well as the additional fiscal revenues the state can collect associated with those gains. Social benefits are related to the additional consumer surplus obtained by the reduction in product prices and/or the increment in the quality of existing goods, which are sold at constant prices.⁹¹
14. Following this methodology, the Feasibility Study of the Project approved by the government presents a series of standard assumptions including the likelihood of being successful when innovating (50 percent), the cost of the investment, sales gains (10x for successful projects), the rate of return for the innovator (10 percent) and the impact on the product price that will benefit the consumer (10 percent). As a result, the private net value related to this subcomponent is US\$18.6 million (PEN68.7 million), and the social benefit linked to this subcomponent is US\$23.8 million (PEN88 million).

⁹⁰ E. Mansfield, J. Rapoport, A. Romeo, S. Wagner, and G. Beardsley. 1977. "Social and Private Rates of Return from Industrial Innovations," *Quarterly Journal of Economics*, 91(5).

⁹¹ In this model, all the consumer surplus is assumed to be captured by a decrease in the price of the existing goods.

Table 13. Private & Social Benefits of Subcomponent 3.2.1

Private benefits	
Investment Costs	USD 6,750,000
(I+D+i)/(Sales)	0.1
Success probability	50%
Expected sales	USD 33,750,000
Sales General Tax (SGT)	18%
State collection	USD 6,075,000
Social benefits	
Price reduction due to innovation	10%
Net sales revenue for innovative product	USD 33,750,000
Constant elasticity	1
Consumer's surplus	USD 3,543,750
Discount rate	8%
Innovator's profitability rate	10%
Sales present value (PV)	USD 226,465,247
State PV collection (SGT)	USD 40,763,745
Private NPV of technological innovative projects	USD 18,570,150
PV of the consumer's surplus	USD 23,778,851
NPV of technological innovative projects	USD 42,349,001

Private and Social Benefits of Subcomponent 2.2.2 - Grants for 6 research projects in strategic areas

15. The private benefits associated with Subcomponent 2.2.2 are calculated using the same methodology presented for Subcomponent 3.2.1, with a few changes in the assumptions: a lower probability of being successful (20 percent) was considered, though successful ventures are assumed to have a larger impact on price (-15 percent) for the benefit of the consumer. The NPV of private benefit of the innovator is then US\$8.9 million (PEN33 million), while the consumer surplus totals US\$17.5 million (PEN64.9 million).

Table 14. Private & Social Benefits of Subcomponent 2.2.2

Private benefits	
Investment Costs	USD 8,100,000
(I+D+i)/(Sales)	0.1
Success probability	20%
Expected sales	USD 16,200,000
Sales General Tax (SGT)	18%
State collection	USD 2,916,000
Social benefits	
Price reduction due to innovation	15%
Net sales revenue for innovative product	USD 16,200,000
Constant elasticity	1
Consumer's surplus	USD 2,612,250
Discount rate	8%
Innovator's profitability rate	10%
Sales present value (PV)	USD 108,703,319
State PV collection (SGT)	USD 19,566,597
Private NPV of technological innovative projects	USD 8,913,672
PV of the consumer's surplus	USD 17,528,410
NPV of technological innovative projects	USD 26,442,082

Private and Social Benefits of Subcomponent 3.2.2 - 20 technology-based ventures in universities or IPIs

16. The private benefits associated with Subcomponent 3.2.2 are calculated using the same methodology presented for Subcomponent 2.2.2, using the same set of assumptions. Following the government's Feasibility Study of the Project, this project is projected to be implemented in two stages. In the first one, the NPV of private benefit to the innovator for this subcomponent is US\$1.7 million (PEN6.1 million), while the NPV of social benefits is US\$3.2 million (PEN12 million). In a second phase, the higher investment cost leads to higher NPVs. The NPV of private benefit to the innovator for this subcomponent is US\$7.9 million (PEN29.3 million), while the NPV of social benefits is US\$7.8 million (PEN28.8 million).

Table 15. Private & Social Benefits of Subcomponent 3.2.2

	Phase 1	Phase 2
Private benefits		
Investment Costs	USD 1,500,000	USD 3,600,000
(I+D+i)/(Sales)	0.1	0.1
Success probability	20%	20%
Expected sales	USD 3,000,000	USD 7,200,000
Sales General Tax (SGT)	18%	18%
State collection	USD 540,000	USD 1,296,000
Social benefits		
Price reduction due to innovation	15%	15%
Net sales revenue for innovative product	USD 3,000,000	USD 7,200,000
Constant elasticity	1	1
Consumer's surplus	USD 483,750	USD 1,161,000
Discount rate	8%	8%
Innovator's profitability rate	10%	10%
Sales present value (PV)	USD 20,130,244	USD 48,312,586
State PV collection (SGT)	USD 3,623,444	USD 8,696,265
Private NPV of technological innovative projects	USD 1,650,680	USD 7,923,264
PV of the consumer's surplus	USD 3,246,002	USD 7,790,405
NPV of technological innovative projects	USD 4,896,682	USD 15,713,669

Economic Evaluation of the Project and Sensitivity Analysis

17. Table 16 presents the economic evaluation of the project, showing that the private and social benefits of the project exceed its social costs. Overall, the project NPV is estimated at US\$6.79 million (PEN25.1 million) at an 8 percent social discount rate. The calculations take into account the social benefits expected over a 10-year horizon for the cases of increased innovation and research, and 15 years for the increase in the number of researchers with PhDs. Taking into consideration all the components, the economic rate of return of the project is 9.4 percent.
18. The economic flows presented in Table 16 differ from those presented by the government's Feasibility Study of the Project, though they present similar results. The latter estimates a project NPV of US\$6.7 million (PEN24.9 million).⁹² There are five differences in the economic flow estimates: (i) Table 16 calculates consumer surplus relative to sales of the same year in all cases; (ii) Social benefits of subcomponent 2.2.2 are considered for 10 years; (iii) The price decrease motivated by innovation assumed for subcomponents 2.2.2 and 3.2.2 is set at 15 percent for all periods; (iv) All social benefits are accrued with a one-year lag; (v) The total cost of the project is considered, without considering other

⁹² See section 4.1.3 of the feasibility study.



costs borne by the Government or the private sector. It should also be highlighted that in both cases the additional fiscal revenue that would be collected as a result of the expected increase in sales was not taken into consideration for the social benefits of the project.

19. The sensitivity analysis conducted as part of the feasibility study explored the effect of changes in the number of successful doctoral students and in the innovators' profitability rate. The results show that the project NPV becomes negative in extreme cases in which only 40 percent of the doctoral students complete their program or when the innovators' profitability drops below 5 percent.⁹³

⁹³ The baseline assumptions for these parameters are:

- Success rate of doctoral students: 75 percent
- Innovators' profitability rate: 10 percent.

Table 16. Flow of Social Costs and Benefits - US\$, thousands

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Increase in number of doctoral graduates (subcomponent 2.1.2) - 290 doctoral grants															
Salary difference doctoral vs master graduates: PEN96,516 (USD26,085)															
Number of scholarships	114	176													
Success rate: 75%															
Overall increase in value added				2,974	7,565	7,565	7,565	7,565	7,565	7,565	7,565	7,565	7,565	7,565	7,565
Expected increase in value added				2,230	5,674	5,674	5,674	5,674	5,674	5,674	5,674	5,674	5,674	5,674	5,674
Development of necessary technologies identified for value chains (subcomponent 3.2.1) - Development of 90 technologies; 50 labs accredited by INACAL															
Number of projects developed		45	45												
Success rate: 50%															
Firm rate of return: 10%															
Price decrease: 10%															
Price elasticity of demand: 1															
Overall sales			33,750	67,500	67,500	67,500	67,500	67,500	67,500	67,500	67,500	67,500	33,750		
Expected sales			16,875	33,750	33,750	33,750	33,750	33,750	33,750	33,750	33,750	33,750	16,875		
Tax revenue (18%)			3,038	6,075	6,075	6,075	6,075	6,075	6,075	6,075	6,075	6,075	3,038		
Firm profit			1,384	2,768	2,768	2,768	2,768	2,768	2,768	2,768	2,768	2,768	1,384		
Consumer surplus			1,772	3,544	3,544	3,544	3,544	3,544	3,544	3,544	3,544	3,544	1,772		
Total net social benefit			3,156	6,311	6,311	6,311	6,311	6,311	6,311	6,311	6,311	6,311	3,156		
Projects for needs of strategic areas (subcomponent 2.2.2) - Grants for 6 research projects in strategic areas															
Number of projects developed	3	3													
Success rate: 20%															
Firm rate of return: 10%															
Price decrease: 15%															
Price elasticity of demand: 1															
Overall sales		40,500	81,000	81,000	81,000	81,000	81,000	81,000	81,000	81,000	81,000	40,500			
Expected sales		8,100	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200	8,100			
Tax revenue (18%)		1,458	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	1,458			
Firm profit		664	1,328	1,328	1,328	1,328	1,328	1,328	1,328	1,328	1,328	664			

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Consumer surplus		1,306	2,612	2,612	2,612	2,612	2,612	2,612	2,612	2,612	2,612	1,306			
Total net social benefit		1,970	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	1,970			
Phase 1 EBT (subcomponent 3.2.2) - 20 technology-based ventures in universities or IPIs															
Number of projects developed	20														
Success rate: 20%															
Firm rate of return: 10%															
Price decrease: 15%															
Price elasticity of demand: 1															
Overall sales		15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000				
Expected sales		3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000				
Tax revenue (18%)		540	540	540	540	540	540	540	540	540	540				
Firm profit		246	246	246	246	246	246	246	246	246	246				
Consumer surplus		484	484	484	484	484	484	484	484	484	484				
Total net social benefit		730	730	730	730	730	730	730	730	730	730				
Phase 2 EBT (subcomponent 3.2.2) - 12 technology-based ventures in universities or IPIs															
Number of projects developed			12												
Success rate: 20%															
Firm rate of return: 20%															
Price decrease: 15%															
Price elasticity of demand: 1															
Overall sales				36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000		
Expected sales				7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200		
Tax revenue (18%)				1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296		
Firm profit				1,181	1,181	1,181	1,181	1,181	1,181	1,181	1,181	1,181	1,181		
Consumer surplus				1,161	1,161	1,161	1,161	1,161	1,161	1,161	1,161	1,161	1,161		
Total net social benefit				2,342	2,342	2,342	2,342	2,342	2,342	2,342	2,342	2,342	2,342		
Total Social Benefits	0	2,700	7,826	15,554	18,997	18,997	18,997	18,997	18,997	18,997	18,997	16,297	11,171	5,674	5,674

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Costs per component															
Component 1	4,808	6,303	3,168	195	0										
Component 2	19,904	20,714	16,554	12,548	4,743										
Component 3	2,871	5,591	10,657	4,080	0										
Component 4	1,972	1,767	1,610	1,610	1,703										
Total Project Costs	29,554	34,375	31,990	18,434	6,446	0	0	0	0	0	0	0	0	0	0
Net Project Benefits	-29,554	-31,675	24,164	-2,880	12,551	18,997	18,997	18,997	18,997	18,997	18,997	16,297	11,171	5,674	5,674

NPV @ 8%	\$6,791
ERR	9.4%