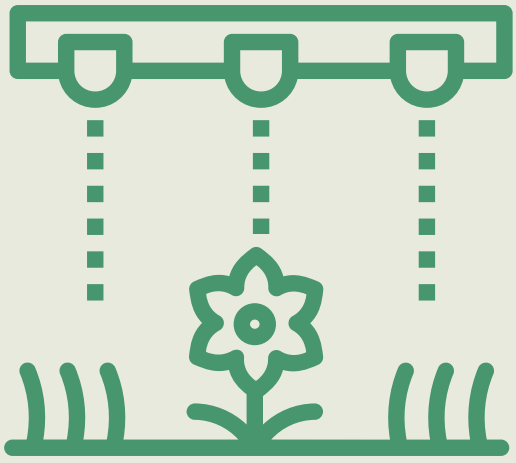
Global Innovation Needs Assessment

Irrigation

Working briefs

September 20, 2021



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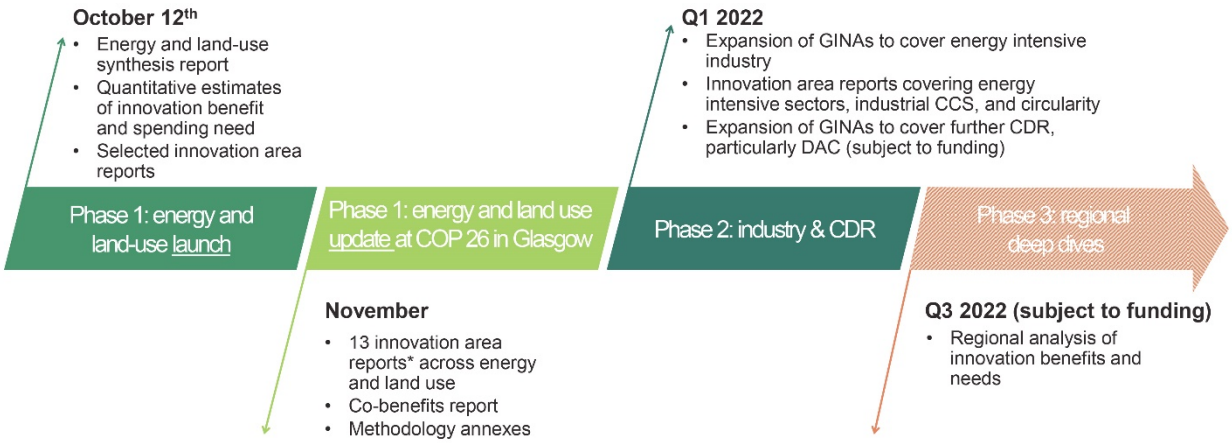
The Global Innovation Needs Assessments

The Global Innovation Needs Assessments (GINAs) is a first of a kind platform for assessing the case for low carbon innovation. The GINAs take a system wide perspective, explicitly modelling the impact of innovations across the global economy. Uniquely, the analysis quantifies the economic benefits of low carbon innovation and identifies the public investment levels—from research and development to commercialization—needed to unlock these benefits. The analysis is divided into 3 Phases: Phase 1 on global energy and land use, Phase 2 on global industry, and Phase 3 on regional deep dives. This irrigation brief forms part of Phase 1 and will be followed by a more detailed irrigation report when Phase 1 concludes.

The analyses do not assess all relevant technologies, nor do they evaluate all relevant factors for policy judgements. Instead, the work is intended to provide a novel evidence base to better inform policy decisions. The Phase 1 analysis looks across a broad range of climate mitigation technologies in energy and land-use, ranging from demand response to protein diversification, to model the economic value of related innovation investment. Later phases expand the research. As with all technologies, there are risks and potential downsides to their adoption, and some remain controversial. Which innovations to invest in is ultimately a policy judgement, and this analysis does not provide policy recommendations to invest in any specific technologies.

Phases of the Global Innovation Needs Assessments



The Global Innovation Needs Assessments project is funded by the ClimateWorks Foundation and the UK Foreign, Commonwealth & Development Office. Analysis was conducted by Vivid Economics. Thank you to the UK Department for Business, Energy and Industrial Strategy (BEIS) analysts and the Mission Innovation Secretariat who were consulted on aspects of the work, and for BEIS support for the 2017-2019 Energy Innovation Needs Assessments which developed the methodological approach taken here.

The findings and views expressed across this project do not reflect the view of ClimateWorks, the Government of the United Kingdom or Mission Innovation.

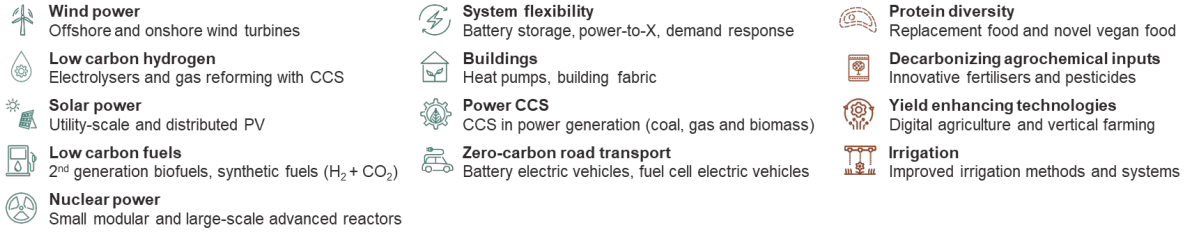
Phase 1 GINA outputs

The suite of reports across innovation areas methodological annexes and a synthesis report for GINAs are available on the GINA website at: https://www.climateworks.org/report/ginas/.

The suite of outputs for Phase 1 of the Global Innovation Needs Assessments

1. **Energy and land use synthesis report –** *slide based summary for policymakers and executives*
   Synthesis of the findings across the innovations considered in energy and land use

2. **Energy and land use & agriculture innovation reports –** *in depth quantitative analysis for industry and policy analysts*



The selected innovation areas were selected for their potential for further innovation and the potential magnitude of the associated system benefits. Their selection here is because they could play a key role in a net zero pathway but does not imply that an optimal net zero pathway necessarily includes them. Further notes on the rationale behind their selection is provided in the methodology annex on the GINA website

3. **Co-benefits of innovation report –** *qualitative analysis of the environmental and other non-economic benefits of net-zero innovation*

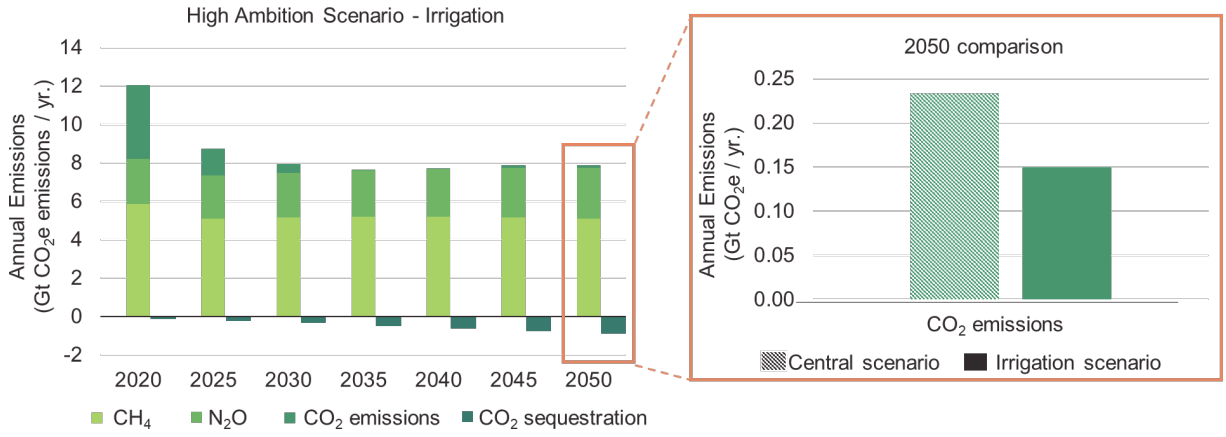
4. **European case study –** *Analysis of jobs and growth benefits in Europe specifically*

5. **Methodology annex–** *A description of the modelling approach taken for analysts*

Irrigation

Irrigation deployment has some potential to reduce greenhouse gas emissions (GHG), making a 1.5°C temperature target US$ 27 billion cheaper to reach between now and 2050. Efficient irrigation techniques, including drip and sprinkler systems, can increase yields by making existing water allocations go further and by reducing soil salination rates and nutrients lost in runoff. These systems can be paired with improved sensors to help identify leaks and better match water applications to crop need or with distributed renewable energy technologies to reduce electricity demand for pumps. Improved efficiency on existing irrigated areas, coupled with expanding irrigation coverage, can reduce greenhouse gas (GHG) emissions by concentrating agricultural production and sparing land to protect and restore natural ecosystems. Figure 1 illustrates the relatively modest improvements in emissions that result from innovation. As a more mature technology category, most of the potential gains in terms of emissions from irrigation expansion are attainable with the increased deployment of current technologies induced by climate and development policy. Innovation in irrigation technologies becomes much more valuable when considering potential water savings.

Figure 1 Left side: The combination of policy and innovation in the high ambition scenario reduces anthropogenic land system emissions substantially compared to today.
Right side: The innovation present in the high ambition scenario (and not in the central scenario) is responsible for moderately less CO_2 per year in the atmosphere in 2050.



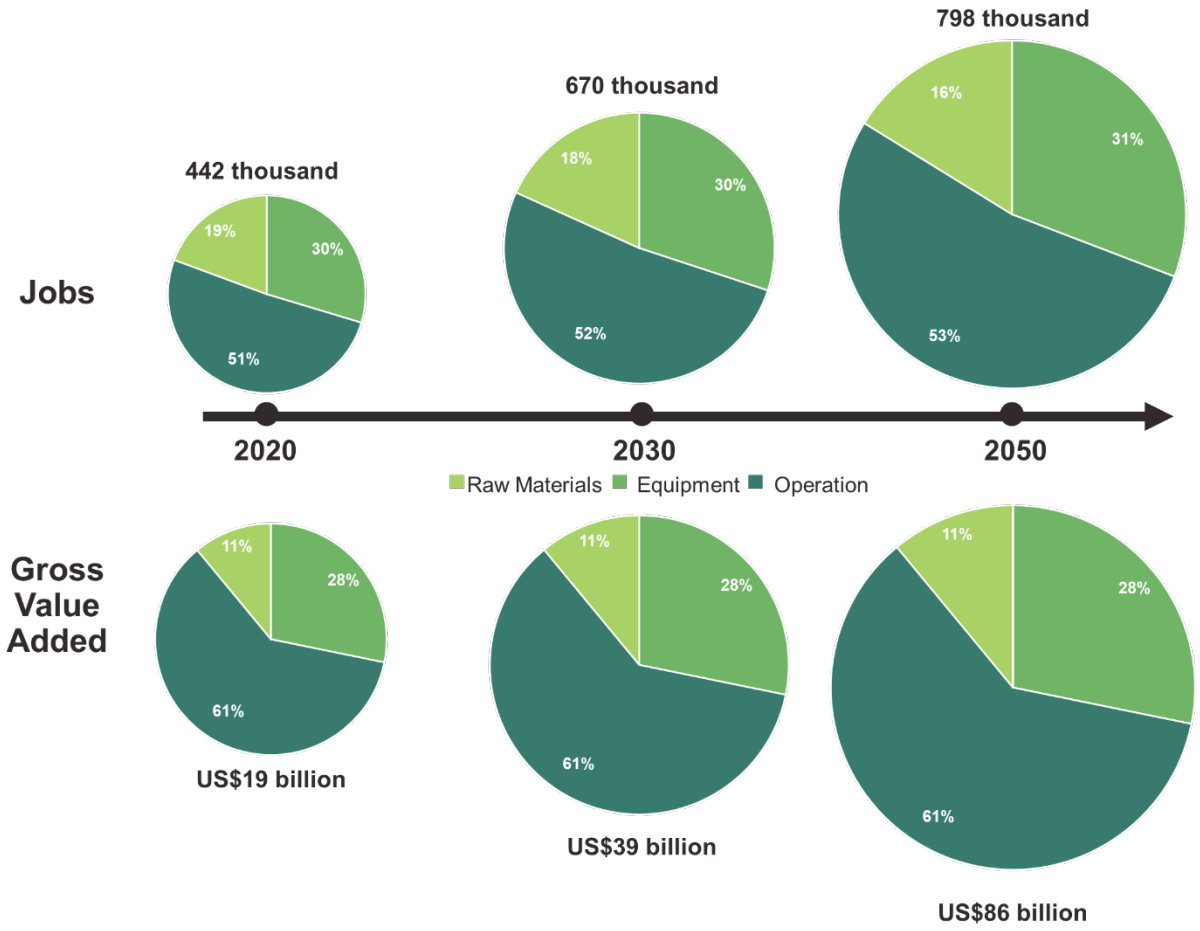
Source: Vivid Economics

While the average emissions reductions are relatively modest, irrigation could play a crucial role in agricultural adaptation to climate change, reducing crop losses that can drive cropland expansion. Rainfed cropping systems are extremely dependent on both the volume and timing of precipitation, which improved water retention and irrigation can mitigate in many environments. By reducing agriculture's sensitivity to extremes, especially in timing, less output would be lost to shifting weather patterns. In addition to improving food security and the resilience of individual farmers, this would help reduce aggregate pressure to expand agricultural area. In the high ambition scenario illustrated in

Figure 1, for example, global cropland falls by 1.2% by 2050 despite a substantial increase in food demand, enabled in part by irrigating an additional 200 MHa globally.[1]

The expansion of this market is associated with significant opportunities, including US$61 billion in gross value added (GVA) and 798,000 jobs globally, by 2050. Figure 2 illustrates the estimated GVA for this new market was valued at US$19 billion in 2020 and could quadruple in magnitude by 2050. Almost 800,000 jobs could be created along the value chain if the innovation potential of this technology is achieved. Jobs related to irrigation equipment and raw materials would increase in 88% and 51% by 2050, respectively. However, farmers may need to acquire new skills to manage these systems efficiently, underscoring the importance of a robust agricultural extension strategy.

Figure 2 Estimates of jobs and GVA growth across the technology value chain resulting from the innovation unlocked with robust public support



Source: Vivid Economics

[1] A fraction of the irrigation expansion potential thought to be sustainable (Rosa et al., 2020).

Irrigation must be undertaken carefully to manage environmental impacts. Over withdrawal of water resources is associated with serious environmental harms and biodiversity loss. Careful management of irrigation, especially when expanding irrigated area, can help ensure sustainable water abstraction limits are not exceeded. Natural solutions for water storage undertaken as part of irrigation water supply can also help mitigate ecosystem harm.

The public sector has a particular role to play in overcoming implementation barriers. While there are emerging innovations, most of the opportunity in irrigation comes from decreasing costs and improving deployment of relatively mature irrigation technologies rather than new R&D. Two barriers are especially salient:

- **Irrigation deployment is capital intensive and relies on common infrastructure.** The costs of irrigation equipment are concentrated up front, while benefits accrue over time, making financing a challenge for many of the world's smaller farms with poor access to capital. Many irrigation options may also require regional investment in common use infrastructure that are impractical for individual actors to undertake.
- **Once established, irrigation infrastructure requires sophisticated management to prevent overuse in dry years.** Given the seasonal and annual fluctuation of water availability, irrigation requires permitting or pricing schemes to manage water withdrawals effectively.

To overcome these barriers and unlock the climate and economic potential associated with irrigation technologies, the public sector should consider agricultural extension and water market reform. For example, countries such as India and Pakistan have dramatically increased irrigation coverage in recent decades through a combination of financial support and informational campaigns.

A NOTE ON METHODS

Quantitative results in this brief are supported by a modelling exercise using a leading land use model and subsequent estimation of job and GVA creation. The Model of Agricultural Production and its Impact on the Environment (MAgPIE), a leading global land use integrated assessment model developed by the Potsdam Institute for Climate Impact research, underpins the analysis undertaken for this project. Quantitative results on emissions and environmental impact rely on the comparison of two scenario types:

- **Central Scenario –** A scenario that models a world of coordinated global action to limit climate change. The scenario limits warming to 1.5^{o}C using only existing technologies
- **High ambition innovation scenarios –** A set of scenarios that illustrate ambitious but realistic support and uptake of a given family of technologies

Scenarios are compared to estimate how much cheaper it is to achieve a given temperature target with the innovation. GVA and jobs increases are then estimated based on the land use and agricultural production outputs from MAgPIE.