



MIDDLE EAST AND
NORTH AFRICA

Iraq

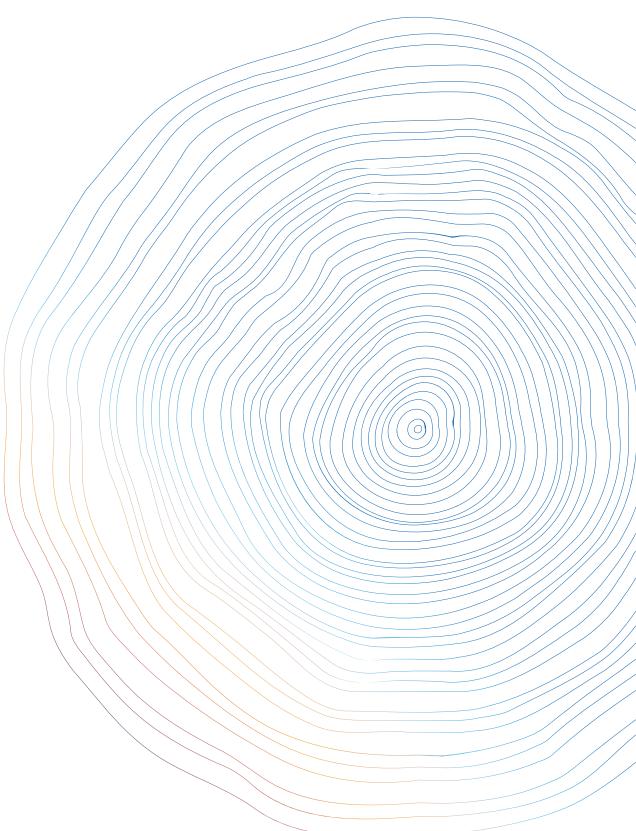
World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

November 2022

“I almost hear the palm trees drink the rain,
And hear the villages moan and emigrants...
With oar and sail they fight
The Gulf storms and thunder, singing
Drip, drop, the rain
Drip, drop, the rain
Drip, drop, the rain...”

Badr Shakir al-Sayyab, Iraqi poet (64–1926)



IRAQ

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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Report design: Dip to color

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Acknowledgments

This Country Climate and Development Report (CCDR) is a collaborative effort of the World Bank, the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA), produced by a core team led by Waleed S. Alsuraih, Amal Talbi, Wael Mansour, Salim Rouhana, and Ali Ahmad. The core analytical team includes Wilfried Hundertmark, Silvia Redaelli, Elizabeth Ruppert Bulmer, Armine Juergenliemk, Carlos Alberto Lopez, and Harika Masud.

Modeling results were provided by Thi Thanh Thanh Bui, Anthony Kubursy, Nobuhiko Daito and Kewwe Sylvester Pela.

Major contributions were received from Monica Vidili, Muneeza Mehmood Alam, Mohammed Qaradaghi, Majid Kazemi, Harsh Goyal, Hogeun Park, Syed Mehdi Hassan, Zivanemoyo Chinzara, Bilal Rabah Al Sugheyer, Khalid Ahmed Ali Moheydeen, Ashwaq Natiq Maseeh.

The team is grateful for the support received from Syed Adeel Abbas, Ramzi Afif Neman, Anne-Cecile Souhaid, Joanna Charlotte Moody, Dima Mohammad Ali Hussein Alhyari, Angela Elzir Assy, Brenden Beck, Mena Cammet, Manu Sharma, Nafie Mohammed Mofid, Waleed Tayseer A Alhaddad, Mohammed Al-Ani, Esha Dilip Zaveri, Iyad Rammal, Rana Haddad, Lemya Izzat Ayoub, Reem Salman Kamel, and Janan Mudalal Aljabiri.

Detailed feedback, suggestions, and comments were received from internal peer reviewers Stephane Hallegatte, Julie Rozenberg, Margaret Arnold and Aditi Maheshwari.

The CCDR benefitted from dialogue with the Government of Iraq and other stakeholders, including members of the CCDR advisory group: Shawkat Jameel, Nabeel Abdul Hussien, Ghufran Dheyab, Ruediger Zimmerman, Dr. Thamer Ahmed, Dr. Nadhir Al-Ansari, Dr. Ramadhan Hamza Mohammed, Dr. Hayder Mohammed Abdul-Hameed Al-Manshi, Dr. Ahmed Saleh Neema, Jassim Alasadi, Hanadi Attieh, Afrah Falih Ali, Janan Al Jabiri and Maha Yassin. Valuable insights were also provided by Dr. Ayaid K. Zgair, Dr. Jamal A. Tawfeeq Al-Ani, Dr. Ahmed Aldhamin, and Dr. Faisel G. Mohammed from the University of Baghdad. The team would also like to convey their appreciation to participants of the focus group discussions that were convened in Basra to inform this report's findings, as well as civil society, private sector and youth representatives whose contributions were integral. Finally, the team is grateful to the Government of Iraq for their guidance and feedback.

The Iraq CCDR was prepared under the guidance of Ferid Belhaj (MENA Vice President), Paul Noumba Um (Regional Director for Infrastructure), Ayat Soliman (Regional Director for Sustainable Development), Nadir Mohammed (Regional Director for Equitable Growth, Finance and Institutions), Saroj Kumar Jha (Country Director), Merli Baroudi (MIGA Director), Aftab Ahmed (IFC Director), and Husam Beides (Practice Manager, Energy).

List of Acronyms

BAU	Business As Usual
BESSs	Battery energy storage systems
Bscfd	Billion cubic feet per day
CAPEX	Capital expenditure
CBAM	Carbon Border Adjustment Mechanism
CCDR	Country Climate and Development Report
CCUS	Carbon capture, utilization and storage
CEDP	cost-effective decarbonization
CO ₂	Carbon Dioxide
CPS	Current Policy Scenario
CR30	Reduction in annual carbon dioxide equivalent emissions of 30 percent by 2040 scenario
CR60	Reduction in annual carbon dioxide equivalent emissions of 60 percent by 2040 scenario
CSA	Climate-Smart Agriculture
EE	Energy Efficiency
EITI	Extractive Industries Transparency Initiative
EPM	World Bank Electricity Planning Model
EU	European Union
EV	Electric Vehicles
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GgCO ₂ e	Grams of Carbon Dioxide Equivalent
GHG	Greenhouse Gas
GoI	Government of Iraq
HFO	Heavy fuel oil
IEA	International Energy Agency
KG	Kilograms
LCH	Low-carbon hydrogen
LCOE	Levelized cost of electricity
MCM	Million Cubic Meters
MENA	Middle East and North Africa
MFMod	World Bank Macro-Fiscal Model
MIGA	Multilateral Investment Guarantee Agency
MWh	Megawatt-hour
NDC	Nationally Determined Contribution
NGFS	Network of Central Banks and Supervisors for Greening the Financial System
OPEC	Organization of the Petroleum Exporting Countries
OPEX	Operational expenditure
PFM	Public Financial Management system
PV	Photovoltaics
RCP	Representative Concentration Pathway
RE	Renewable Energy
SDGs	Sustainable Development Goals
SOEs	state-owned enterprises
SWLRI	Strategy for Water and Land Resources of Iraq
MtCO ₂ e	Metric tons of carbon dioxide equivalent
UMICs	Upper-middle-income countries
UNFCCC	United Nations Framework Convention on Climate Change
WUE	Water use efficiency

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Executive Summary

Executive Summary

Iraq's Intertwining Development and Climate Realities: An Urgent Call for Action

In Iraq, a multidimensional development and climate crisis is brewing. Iraq's oil-dependent development model, weakening human and institutional capacity, and its deep social divides and inequalities are ingredients of a “perfect storm” centering on a development-climate-fragility nexus. Iraq is among the countries most vulnerable to climate change shocks both in physical (temperature rise, water scarcity, extreme events) and financial terms. Iraq's dependence on oil revenues would leave it vulnerable to new economic risks amid the global transition toward a decarbonized world, wherein oil as a commodity loses its role in fuelling the global economy.

Iraq's oil-led growth model has been a source of fragility and economic volatility, particularly impacting the country's growth potential and sustainable development. Despite being one of the largest oil producers in the world and almost doubling its oil production in the past decade, Iraq's development indices resemble that of low-income countries. For example, only 13 percent of Iraqi women participate in the labor force, which is the second lowest level in the world after Yemen. The Iraqi education system is one of the weakest in the region. It is estimated that a child born in Iraq will only reach 40 percent of their potential, reflecting an extremely low level of human capital, only ahead of Yemen and Sub-Saharan Africa. The extensive (and extractive) role that oil rents play in Iraq's economy, and consequently in its public spending, transfers, and employment (two-fifths of all jobs are in the public sector), represents a major resilience challenge. Moreover, oil dependency continues to undermine export competitiveness of non-oil sectors, which are critical for the country's move towards economic diversification and are the focus of most local private sector operations.

Climate change threatens the social contract in Iraq, which has already been eroded by elite capture, widespread clientelism, corruption and limited voice and accountability. Iraq's current rent-based and power-sharing political settlement is unsustainable. Immediate rent-seeking is impeding oil rent maximization for low-carbon investments, the rebuilding of public institutions, and the government's capacity to foster trust and address deep divisions and fragility. Climate change, as this report shows, is already fueling inequalities in Iraq, which could ultimately spark further rounds of civil unrest and fragility. Within this context, various governing and governance forms are set not to deliver on their original intent. For example, so long as federalism is construed as a zero-sum game, where the gain of one tier of government has to be at the expense of another, rent sharing and short termism will remain the over-riding objectives.

The Iraq CCDR adopts a “people centric” approach to achieve a deeper understanding of current climate change effects and potential impact of low-carbon transition on vulnerable groups. The CCDR analysis conducted a Stakeholders Engagement Plan with civil society and private sector as priority to establish essential foundations for climate dialogue and inform both the analytics and development of policy levers. This involved organizing in-person focus group discussions with oil workers, agricultural workers and women's groups, as well as dialogues with university students and youth. This effort also entailed forming a CCDR advisory group comprised of representatives from the Government of Iraq, the private sector, and academics. Additionally, a social media survey to understand the Iraqi's perspective on climate change issues and effects. These engagements validated the increased awareness and trepidation of urban and rural inhabitants on the urgency of adaptation measures to cope with water scarcity, reduced agricultural yields, the impact of high temperatures on labor health and productivity and limited options for unskilled workers to adjust to climate induced changes in the labor market. Inputs from various stakeholders also reinforced the need for coherent approaches towards locally led

and participatory climate change actions, as well as social protection and human capital development policies that would pave the way for a just low-carbon transition, particularly for Iraq's most vulnerable and disenfranchised groups.

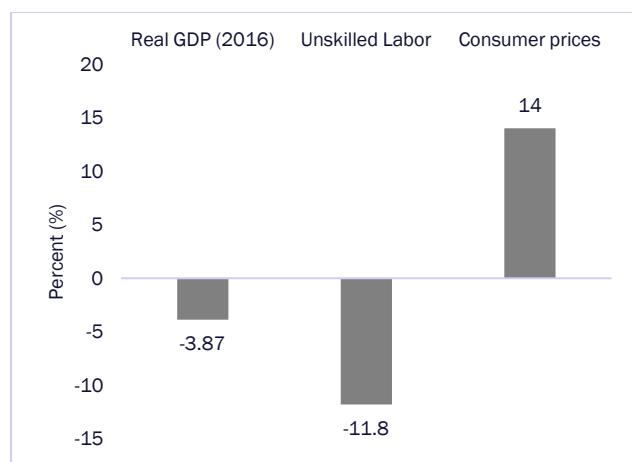
The current state of Iraq's private sector limits its ability to contribute to climate action or to mobilize green finance. The dominant role of the public sector continues to constrain private sector growth and job creation. The private sector has been undermined by decades of state control (both directly and indirectly, through state-owned enterprises), complex political economy, the security situation, knowledge gaps, limited access to finance, and shortages of skilled labor.

The intersection of Iraq's development gaps and climate change vulnerabilities call for a rethink of how best to address these combined challenges and respond to the needs and aspirations of the Iraqi people. This Iraq Country Climate and Development Report (CCDR) prioritizes actions in three focus areas: (i) adaptation, with a focus on the water-agriculture-poverty nexus, (ii) mitigation, with a focus on decarbonizing Iraq's energy value chain, and (iii) managing the macro-fiscal implications of the transition to a low-carbon economy. The report's recommendations will not address all the challenges of Iraq's low-carbon transition but aim at closing development gaps and setting the country on a path toward a greener and more resilient economy in 2022–40.

[The High Price of Climate Inaction: What's at Stake?](#)

Iraq is quickly running out of water, and in a business-as-usual scenario, the widening gap between water supply and demand in Iraq is expected to increase from around 5 to 11 billion cubic meters by 2035, which would represent more than 15 percent of the total water demand. Climate change will worsen the decline in water availability and reduce many crop yields, and adversely impact GDP, fiscal capacity, poverty reduction prospects and social stability. Without any climate adaptation efforts, increase in temperature and potential decrease in rainfall will further widen the 10.9 billion cubic meters gap.¹ The impact of a 20 percent decline in water availability and higher temperatures on crop yields could lead to a 3.9 percent reduction in GDP in the medium-term (see Figure ES1).

Figure ES1: Estimated impact of 20 percent reduction of water supply and temperature impacts on crop yields in Iraq



Impact of climate change will have wide ranging socio-economic consequences affecting all economic sectors and negatively impacting labor demand, particularly for unskilled labor. Decline in unskilled labor demand, coupled with projected increases in food prices stemming from reduced crop production,

¹ According to the Strategy for Water and Land Resources of Iraq (SWLRI)

will disproportionately affect the poorest and most vulnerable segments of the population (see Figure ES1). Improvement in water use efficiency, an example of water adaptation, can counterbalance these trends, mitigating the socio-economic costs of inaction. Estimates indicate that the reduction in GDP would shrink to 3.1 percent and 2.4 percent with 10 percent and 20 percent improvements in water use efficiency, respectively.

Without intervention, water scarcity and suboptimal water quality pose significant risks to Iraq's agri-food systems. The agriculture sector is important to Iraq's economy and its food security. In 2020, the sector's share of GDP was 5.9 percent and it employed approximately 9 percent of workers. The broader agri-food sector contributes a higher percentage of GDP when related value chain activities are counted. Agriculture's share of annual freshwater withdrawals is about 79 percent, while water scarcity is increasing due to rising water demand and reduced runoff and decreased transboundary water flows. Crop production in Iraq relies on irrigation due to the low productivity of rainfed cropping. The share of irrigated area in total harvested area was about 91 percent in 2016.

Worker productivity faces direct risks from climate change through exposure to higher temperatures. Agriculture and construction sector workers are expected to be the most affected by hotter working conditions: 35 percent of Iraq's agricultural workers and a similar share of construction workers are exposed to extreme heat conditions. And in agriculture and construction in particular, where jobs are rarely formal or salaried and where compensation is directly tied to output, reduced labor productivity translates into lost earnings. This concern was confirmed in discussions with agricultural workers as well as oil workers from Basra, especially those who work in maintenance and are consistently exposed to temperatures exceeding 50 degrees Celsius.

Almost three quarters of Iraq's total carbon emissions are attributed to the energy sector (electricity, oil and gas operations and transport). Although Iraq accounted for only 0.6 percent of global CO₂ emissions in 2020, its emissions have doubled over the last decade alone. Moreover, Iraq has one of the highest levels of carbon intensity (emissions per GDP) compared to its regional and income peers. Power generation, flaring and venting of natural gas and fugitive leakages of methane are responsible for more than 60 percent of the country's emissions. In 2019, more than 98 percent of electricity in Iraq was generated by fossil fuels (55 percent from natural gas and 43 percent from oil). By addressing electricity, oil and gas operations (flaring) and transport, this CCCR tackles the decarbonization of Iraq's major emitting sectors. Overall, the studied scenarios cover 86 percent of energy-sector related emissions, and 75 percent of total emissions in Iraq.

In 2020, Iraq's flared natural gas represented US\$2.5 billion in foregone annual value and would have been sufficient to fuel more than 10 GW of much-needed electricity generation capacity. Iraq ranks second in the world, after Russia, for the volumes of gas flared. The country flares 1.7 billion cubic feet per day (Bscfd) of associated natural gas, and imports up to 1 Bscfd from Iran to use for power generation. Iraq's flared gas volumes account for around 14 percent of the country's total emissions, among the highest levels in the world.

Without key structural reforms, Iraq's pursuit of a resilient, inclusive and diversified growth path will not materialize. Reforms that target improving resource allocation and management, cost recovery in the electricity sector, fiscal consolidation and boosting domestic revenue mobilization, improving business and financial sector environment, and securing private investments and new job creation are critical for Iraq to cushion the adverse physical and fiscal effects of climate change. Delays in implementing these reforms will make it harder for Iraq to afford its growing investment needs, including in its water and power sectors.

Defining Iraq's Resilient and Low-Carbon Development Pathway

Water Sector: Adaptation actions focused on the water-agriculture-poverty nexus would increase water productivity, diversify the economy, create employment, improve the quality of jobs and livelihoods, contribute to food security, and support resilience of the most vulnerable people. To that effect, recommended policy levers along three pillars (infrastructure, innovation, and institutions) include the following:

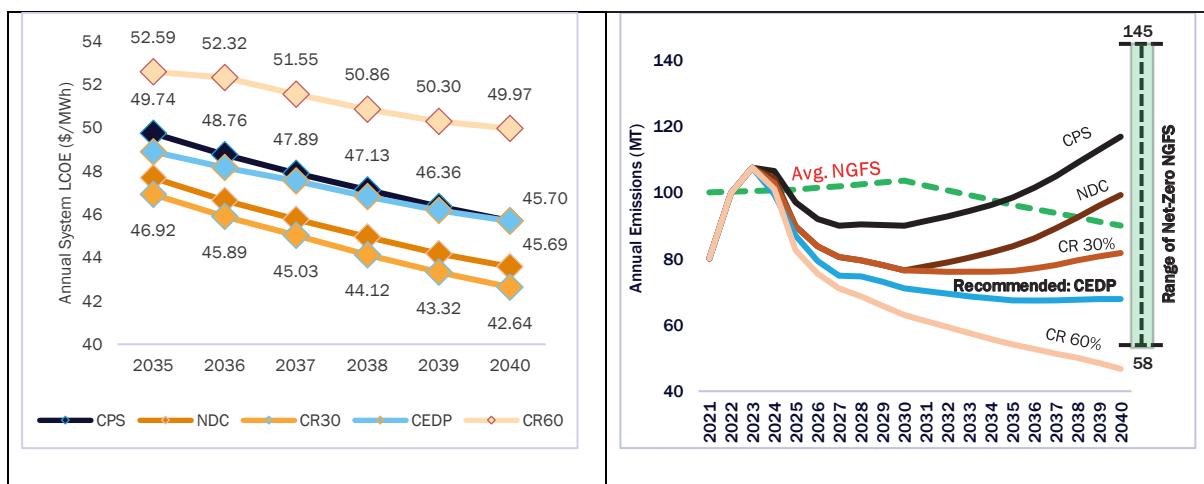
- Improve regional cooperation and at national level enhance water use efficiency and productivity jointly with demand management policies, and improve water allocation and appropriate valuation
- Modernize irrigation and drainage systems, manage salinity, and rehabilitate and update the operation of dams
- Implement climate-smart agricultural options by, for example, promoting drought and heat-resistant crop varieties and improving soil management
- Repurpose public sector support and policies (including subsidies) toward sustainable outcomes in the water and agricultural sectors, and de-risk investments in the agri-food sector
- Adopt and implement a cross-sectoral governance and coordination framework with adequate provisions for transparency and public engagement to plan, implement and monitor climate change actions at the national and subnational levels.

Electricity Sector: Progressive expansion of renewable energy minimizes electricity generation's costs and improves energy security while reducing emissions. In 2021, the electricity supply-demand gap was estimated at 12 GW, equivalent to 44 percent of available generation capacity. Addressing this gap while considering mitigation measures would require a gradual phasing out of liquid fuels, the strengthening of system generation availability and flexibility using gas-based generation, investment in renewable energy, and the use of electricity imports from reliable sources. With these considerations, a cost-effective decarbonization (CEDP) scenario is the recommended pathway for decarbonizing Iraq's power sector. It tackles electricity supply-demand balance requirements head on, and it minimizes the levelized cost of electricity (LCOE) (see Figure ES2a). The share of renewables in total generation capacity in 2040 is projected to be 31 percent. The CEDP pathways also prevents the consumption of liquid fuels for power generation, reducing the power sector's emissions by 42 percent. Compared to a global benchmark of net-zero pathways for all countries, namely the net-zero scenarios put forward by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS),² the CEDP pathway for the power sector produces about 25 percent less emissions in 2040 (see Figure ES2b).

Transport Sector: In the recommended pathway for Iraq's transport sector, which focuses on a modal shift rather than electrification in the short to medium term, key actions are needed to respond to the rapid urbanization of Iraqi cities, lower air pollution, and reduce the transport sector's emissions. A "high ambition" scenario (equivalent to the CEDP) reduces carbon emissions by 16 percent by 2040. Inducing a modal shift away from private cars toward greener modes—like public transport and railways—promises greater gains per dollar invested than would electrifying these modes (power supply shortages also limit the potential of e-mobility for now).

² The NGFS emissions projections are based on three different Integrated Assessment Models, run by three different modeling groups. The modeling is done at a regional level and is then downscaled to the national level. Throughout the Iraq CCDR, the NGFS scenarios are not used as predictions but rather indicative of what-if possibilities.

Figure ES2: (a) Annual leveled cost of electricity across scenarios; (b) Annual power sector emissions across various electricity scenarios



Note: CPS (Current Policies Scenario); NDC (Nationally Determined Contributions scenario), CR30 (reduction in annual carbon dioxide equivalent emissions of 30 percent by 2040 scenario); CEDP (Cost-Effective Decarbonization Scenario); CR60 (reduction in annual carbon dioxide equivalent emissions of 60 percent by 2040 scenario).

Energy-related Sectors Low-Carbon Pathway: The recommended combined CEDP scenario for the electricity and transport sectors, which includes eliminating gas flaring, cuts more than 86 percent of energy-related emissions and is comparable to the NGFS net-zero pathways. The combined CEDP offers a decarbonization pathway that is below the average NGFS net-zero projections and is closer to the lower end of their emissions range.³ The combined CEDP pathway produces 17 percent less emissions compared to the average NGFS emission levels in 2040. Recognizing Iraq's complex development and climate change realities, this decarbonization pathway is considered feasible and more ambitious in comparison with the national NDCs. The pathway is expected to unlock the low-carbon transition in Iraq by tackling the key sectors driving the emissions until 2040.

Beyond 2040, greater technological diffusion would be timely for Iraq, especially CO₂ capture, utilization, and storage (CCUS). CCUS and low-carbon hydrogen (LCH) are two cross-cutting technologies that can allow Iraq to leverage rich energy endowments to support development outcomes while at the same time meeting national and international climate mitigation targets. Iraq has extensive CCUS and LCH potential, including the requisite natural resources as well as oil and gas sector experience and skills that can be applied to these new opportunities. Supporting a just transition in these sectors is possible, but further assessment is required to understand these technologies' potential in Iraq, while government action is needed to ensure they are deployed when required.

Managing the Macro-Fiscal Implications of the Low-Carbon Transition

Economic diversification-focused reforms, including through boosting non-oil related revenues, go beyond mitigating climate change; they will support growth and increase the economic returns from the transition. Aside from climate action, economic diversification to reduce reliance on oil is critical for Iraq's future. Implementing diversification related reforms would raise Iraq's GDP per capita by 58 percent by raising non-oil related capital accumulation, boosting human capital formation, and address labor force participation bottlenecks, especially for women.⁴ As the macroeconomic results summarized

³ The lowest range is the REMIND-MAgPIE 2.1-4.2 model.

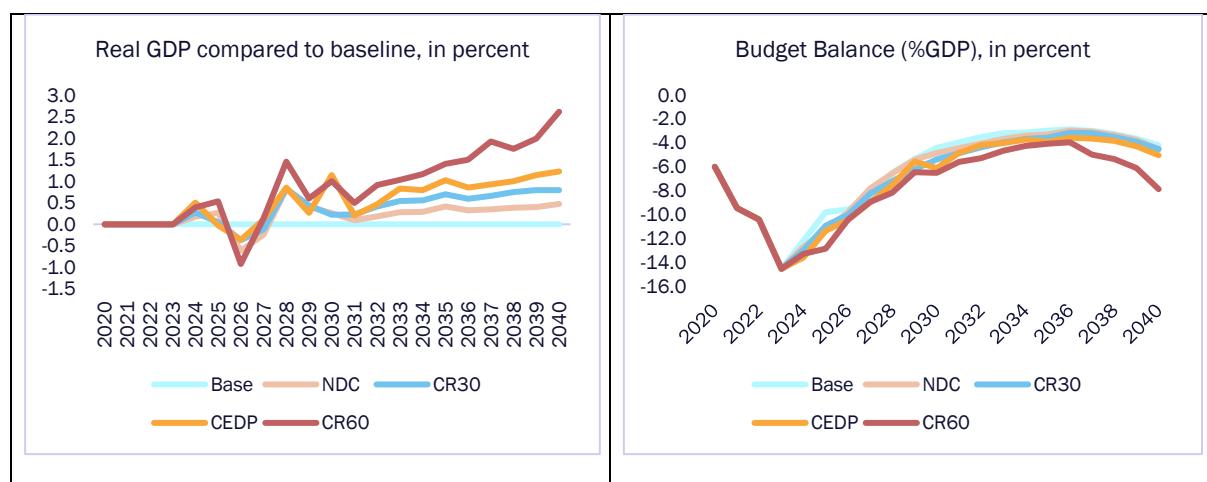
⁴ See Iraq CEM 2020 for a detailed description on reforms, impact, and methodology (World Bank 2020a).

below show, economic diversification reforms will make the transition more feasible and more rewarding. Hence, undertaking this transition under reform conditions would raise total GDP and non-oil GDP by 6.5 and 9.9 percent, respectively.

All decarbonization pathways for the electricity sector bring additional growth and productivity gains compared to existing plans or maintaining the status quo (see Figure ES3). Thus, to proceed with an investment program that would switch the electricity generation fuel mix to favor natural gas and raise the contribution of renewables would have financial benefits. However, any decarbonization pathway (including existing Gol plans) is fiscally costly given the current energy subsidies and substantial upfront capital expenditure required to depart from relying on hydrocarbons for economic activity and growth. After including the cost of fuel subsidies, commercial losses, and non-technical losses, around 90 percent of annual operational costs are currently not recovered in Iraq's power system. This cost could prove to be fiscally steep in deep decarbonization scenarios, especially if the transition is fully financed by the budget.

Reforms can help absorb the costly adaptation package in the face of water scarcity. An adaptation package of US\$70 billion of frontloaded investments and operational spending till 2040 is identified. This includes (i) critical infrastructure programs for the rehabilitation of dams, barrages, regulators, drains and canals; (ii) reclamation and modernization of irrigation (on-farm and off-farm); as well as (iii) soft investments in public and private water service institutions and programs (e.g. capacity building of farmer-led organizations, cost recovery policy reform, and update of the operations of dams); and (iv) water security and conservation programs.⁵ These adaptation measures are estimated to reduce water scarcity by half (down to 10 percent). Macro simulations reveal that introducing this package would add 0.12 percent to the GDP in the first 5 years on top of the gains from the CEDP transition pathway and the accompanying fiscal reforms (0.87 percent gain by 2040). However, it would come at a fiscal cost where the budget deficit would average at 11 percent of GDP in the first 5 years before declining to an average of 4.3 percent thereafter. Deeper fiscal reforms, growth-enhancing structural reforms and availing private financing for investments would make the adaptation measures more affordable.

Figure ES3: Decarbonization pathways are supportive of growth, but the transition will come at a fiscal cost and will have an impact on public debt levels



Reforms are key to the resilience of Iraq's low-carbon transition. Key objectives include (i) ensuring the cost recovery of services, most notably in the electricity sector due to its size, (ii) improving the targeting

⁵ Labor-related investments are not included.

of electricity subsidies, (iii) fiscal consolidation through public wage bill controls and the mobilization of domestic revenue, and (iv) mobilization of green public and private sector financing and participation in the transition.

In line with expected positive impacts on GDP growth and private consumption, investments under the decarbonization electricity pathways are expected to help reduce poverty, albeit marginally. According to baseline simulations, poverty in Iraq—as measured at the US\$3.2 international poverty line—is expected to remain stable over the period 2025–40. By 2040, under the recommended CEDP pathway, the share of Iraqis living below the US\$3.2 international poverty line is expected to decline by 0.83 percentage points compared to the baseline. The decline in poverty is expected to increase the higher the investment and the deeper the decarbonization pathway.⁶ Inequality is expected to increase marginally over time, with no sizeable differences across scenarios.

Iraq's low-carbon transition is highly susceptible to global oil markets given Iraq's overdependence on oil. As a sensitivity test, low oil prices in a scenario where countries achieve net-zero emissions targets would be detrimental and would hinder Iraq from investing in meeting its domestic energy needs. To mitigate this effect, it will be important for Iraq to move forward with an economic diversification agenda, benefit from current high oil prices to accelerate the pace of investment in the energy transition as a new economic lever, as well as adopt fiscal rules. Moreover, creating a sovereign wealth fund (SWF) is now more relevant and vital for Iraq's economic growth and resilience. The global energy transition is inevitable, and the pace of such transition is accelerating. A SWF would enable Iraq to attract foreign capital and have a much-needed economic stabilizer to weather potential future losses from the global decarbonization trends.

Ensuring an Inclusive and Just Transition

Transitioning to a low-carbon economy in Iraq will not only affect jobs related to oil production; it also brings risks that may trigger deep economic and societal transformations. Whereas Iraq's oil sector employs less than 1 percent of the workforce, the far bigger challenge is the size of the public sector workforce, which accounts for a large share of total employment both at the national and regional levels. As the world transitions away from fossil fuels and demand for Iraq's oil exports eventually weakens, the resulting reduction in oil revenues will constrain government resources and create pressures to reduce public employment.

Climate change impacts – including through increased water scarcity and higher temperatures – also threaten jobs and livelihoods across the private sector, especially jobs within agriculture and related value chains, with unskilled labor disproportionately affected. The CCDR findings point out that within agriculture, the projected negative impact of water scarcity on jobs is larger than the impact on production, especially for unskilled jobs, which will decrease by 11.5 percent in the medium term. After construction, agriculture is the main sector of employment for the poor. The impact on jobs outside of agriculture are the cumulative result from multiple channels. Lower agricultural output will affect downstream industries such as food processing and services like food retailers, restaurants and hotels, and associated construction and transport.

Climate actions to address emissions and resource efficiency can contribute to a just and inclusive transition by creating more and better jobs in multiple sectors, particularly if accompanied by policies to facilitate adjustment and upskilling of the labor force and private sector development. Investments in decarbonization and energy efficiency will stimulate labor demand in renewable energy generation,

⁶ Findings are driven by higher real wages and household consumption compared to the baseline scenario.

installation, maintenance and building efficiency upgrades, each requiring a range of skills. Complementary investments in skills – both in-work and through formal technical training/education – will help Iraq's workers meet this new demand. Related emerging industries will create entrepreneurship opportunities such as delivering energy audits and monitoring and green building design services. Incentivizing and training farmers to adopt climate-smart crops and sustainable production methods will improve yields and raise incomes. Social dialogue and social protection measures that mitigate job losses or threatened livelihoods are key. Payments for environmental services could both protect vulnerable ecosystems and sustain households subsisting on marginal lands. Looking ahead, future labor market entrants must be more climate-aware, innovative and better prepared to respond to the challenges of green transition.

Low-Carbon Transition Policy Levers Framework: Priorities and Recommendations

The Government of Iraq cannot adopt all the recommendations needed at once; prioritizing interventions is essential to address urgent needs with significant benefits. Throughout this report, the recommended policy levers and associated investments aim to close the development gaps and set Iraq's growth towards a greener and more resilient trajectory. The selected levers were carefully considered in multi-stage discussions with a diverse set of stakeholders, including representatives of the Government of Iraq, focus groups with sectoral employees, academics, civil society groups, private sector players, and development partners.

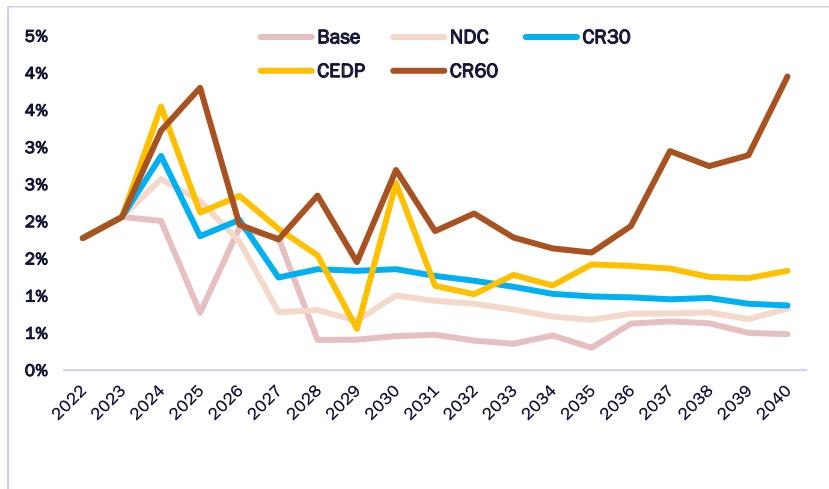
By 2040, the Iraq CCDR recommends US\$233 billion of investment needs that would meet Iraq's major development needs and allow Iraq to embark on a green growth path. The CCDR prioritizes and sequences these investments in ways that reflect their urgency, synergies, and tradeoffs in responding to Iraq's immediate development and climate needs. The recommended measures are summarized in Figure ES4. The "no-regret" measures, which are recommended in the initial five years (starting in 2022) offer Iraq the chance to respond to development needs and establish foundations of climate action while achieving low-carbon transition benefits (efficiency and social welfare, new jobs, fiscal savings, etc.) at relatively low economic cost. Short- to medium-term measures, which are recommended over the coming 10-year period, are critical for Iraq to build economic and social resilience and set a greener transition pathway that shifts the approach of designing and executing mitigation and adaption policies in preparation for deeper climate action in 2030-2040.

Figure ES4: Prioritization and investment needs of recommended policies and interventions

		NO REGRET MEASURES FOR IMMEDIATE BENEFITS		Identified "no regret" and "high impact" investments		(US\$ billions) By 2040
		Urgent interventions with low tradeoffs		Rehabilitation of hydraulic infrastructure and irrigation, and reclamation of irrigation		42
		Medium-term measures		Water and agriculture non-structural investments		6
Development Urgency		Less urgent, but highly beneficial interventions		Eliminate gas flaring and utilize it in power generation		29
High		Long-term interventions to keep in mind		Adopt the CEDP pathway for the power sector		63
Low		<ul style="list-style-type: none"> Invest in CCUS and LCH Diversification of energy exports Expand E-mobility Decarbonize industry, agriculture and waste sectors Leverage regional trade and connectivity 		Overhaul the power grid		52
High		<ul style="list-style-type: none"> Improve water allocation and reuse of wastewater Adopt and scale-up climate smart agriculture Initiate methane abatement in the oil & gas sectors Apply short and long-term labor transition policies Curricular reforms to shift towards STEM-Climate knowledge space Launch CC outreach and public participation program and scale up local participatory approaches 		Adopt the "High Ambition" transport decarbonization pathway		31
Low				Total		233

Spread equally across the 19-year horizon until 2040, the annual investment requirement would be equivalent to 6 percent of GDP per year. Under the CCDR's proposed path (CEDP) the electricity investment is slightly frontloaded with 28 percent of total CAPEX (2.3 percent of GDP) being required by 2025 (see Figure ES5). This is the case for some of the other investment as well. According to official data, annual investment in Iraq in 2015-2020 averaged 17 percent of GDP, out of which public sector investment accounted for more than half (67 percent). In recent years, most of the government investment budget has been allocated to the oil sector (annually 3.8 percent of GDP in oil versus 1.6 percent of GDP in non-oil on average in 2017-2021). Thus, while securing financing for the proposed investments are feasible, considering recent improvement in external reserves standing currently at US\$80 billion, these investments need to be complemented by other measures. Crucially, fiscal and pro-growth reforms are needed to mobilize domestic revenues and create fiscal space to meet part of these investments, especially considering the volatility in oil revenues. Utilizing external financing sources will also be necessary to avoid crowding out private sector investment and increasing borrowing costs for other investments.

Figure ES5: CAPEX investments as a share of GDP (%)





1

Development and Climate Context

1. Development and Climate Context

1.1. The Legacy of Conflict and Failed Reconstruction

Decades of wars and instability have hindered Iraq's human, social, and economic development. This in turn has resulted in limited infrastructure and service delivery improvements, weak job creation, and inadequate investment in human capital. Significant waves of conflict and violence forcibly displaced 6.14 million Iraqis between 2010 and 2017. Post-2003, reconstruction efforts have failed to diversify Iraq's economy away from oil. Iraq remains one of the least diversified and most oil-dependent economies in the world. In 2019, oil revenues' share in both the Iraqi government budget and exports were 92 and 96 percent, respectively. Such dependency, alongside constrained private sector development (particularly in the non-oil sectors), has hindered the potential to generate employment opportunities (Matsunaga 2019).

Reconstruction efforts also failed to bridge service provision gaps and rebuild the country's human capital. In 2021, one-third of Iraq's electricity demand remained unmet, with Iraqis relying on expensive and polluting diesel generators to fill the gap. In terms of human capital development, before the first Iran-Iraq War in the 1980s, Iraq possessed one of the best education systems in the region. By 2017, however, 3.2 million school-aged Iraqi children were out of school. Conflict-affected governorates such as Salah Al-Din and Diyala saw more than 90 percent of school-aged children drop out of the educational system, especially girls (UNICEF 2017).

1.2. The People-Climate-Development Nexus

Compounded by high levels of fragility, macroeconomic volatility, and depleted human and institutional capacity, climate change presents a challenge to Iraq's economic and social prosperity.⁷ Iraq's imbalanced, oil-dependent development model, its social profile, and its environmental profile are ingredients of a "perfect storm." Climate change risks are already shaping Iraq's development path through impacting its growth and potential for economic diversification as well as further straining the fragile social contract in the country.

The poverty rate in Iraq is among the highest in upper-middle-income countries (UMICs), with significant and persistent regional and group disparities being compounded by climate change. There is a stark rural-urban divide evident in monetary poverty rates, which are almost double in rural vs. urban areas of Iraq (World Bank 2020a). In terms of nonmonetary welfare, there appears to be a north-south divide, with the Kurdish governorates performing better than the national average and the notably underdeveloped south (World Bank 2020a).⁸ The poorer and least developed southern parts of Iraq, which already suffer from inadequate quantities of quality water, are the most vulnerable to climate change effects such as increased water scarcity and higher temperatures.

The impacts of climate change-driven water scarcity are already felt by the Iraqi people and deteriorating their well-being and human capital. The global evidence of the long-lasting, negative consequences of climate shocks on people, particularly at the earliest stages of life, is overwhelming. For example, severe water scarcity will have direct impacts on childhood stunting, which

⁷ For more details about Iraq's economic, social, political, and environmental risks, please refer to the 2021 Iraq Country Partnership Framework (World Bank 2021c).

⁸ Especially Qadisiyah, Muthana, Thi Qar, Missan, and Basrah.

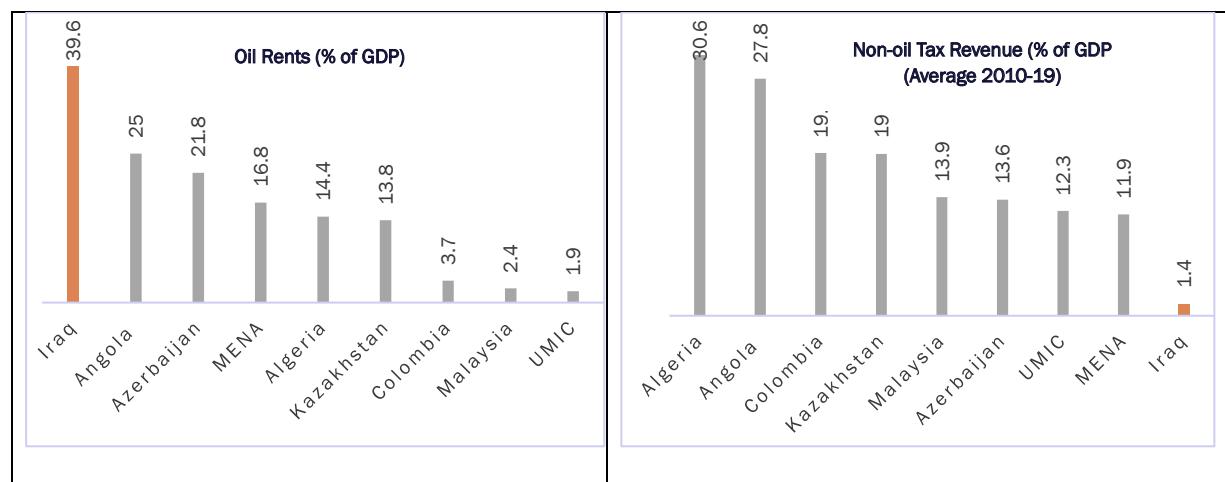
is well documented to decrease a child's future health and productivity. For the poor and vulnerable, managing these shocks can result in behaviors that further erode human capital.

1.3. Development Gaps and Lagging Reforms

Iraq's oil-led growth model is a source of fragility and economic volatility, particularly impacting the country's growth potential and sustainable development. Compared to a group of peers, Iraq exhibits a much higher oil dependency, particularly in terms of oil share and non-oil tax revenue of the gross domestic product (GDP) (see Figure 1).⁹ The extensive role oil rents play in Iraq's economy, and consequently in its public spending, transfers, and employment (two-fifths of total employment are public), represents a major weakness. Oil dependency undermines the export competitiveness of non-oil sectors, where the local private sector largely operates. Also, the high oil dependency heightens the vulnerability of GDP, public revenue, and exports to oil price volatility and other exogenous shocks. This is evident in the sharp economic contraction associated with the oil price slump caused by COVID-19, and a sudden change in economic prospects associated with a positive oil market shock resulting from the war in Ukraine.

Despite its oil wealth, Iraq's development context resembles that of low-income countries. Compared to its peers in various regional and income groups, Iraq is one of the worst performers in terms of inclusion among Middle East and North Africa (MENA) countries, with an inclusion level close to highly fragile states such as Syria, Libya, and Yemen. Regarding gender parity, only 13 percent of Iraqi women participate in the labor force, which is the second lowest level in the world after Yemen. Regarding education, it is estimated that a child born in Iraq will reach only 40 percent of her potential, which is one of the lowest levels of human capital in the world, only ahead of Yemen and Sub-Saharan African countries (World Bank 2021b). The public sector is estimated to account for about 60 percent of the economy (GDP), while the private sector remains very weak, undynamic, and largely informal. Iraq's GDP per capita could be up to 60 percent higher if it had similar levels of private sector participation, investment, human capital, and productivity as UMICs in a comparable income bracket (World Bank 2021c).

Figure 1: Iraq's oil dependency in numbers



Sources: World Bank data and World Bank 2020a.

⁹ The selection of Iraq's peers is based on a methodology outlined in the Iraq Economic Memorandum, September 2020 (World Bank 2020a).

Iraq's oil dependency and public sector dominance have resulted in persistently poor labor market outcomes. Iraq's highly segmented labor market—between urban and rural, public and private, formal and informal, male and female, youth and non-youth—impedes workers' capacity to move between segments to find better jobs. The gaps in access to good employment opportunities are especially problematic for households' ability to respond to income shocks. Only 45 percent of the working-age population is active, compared to 50 percent on average for the Arab states and MENA, primarily driven by very low rates of female participation. Iraq's large public sector creates significant labor market distortions: a skills mismatch occurs as students prioritize academic disciplines relevant to or valued by the public sector rather than those in demand by the private sector. The majority of private employment is informal,¹⁰ much of it in low-productivity, low-quality jobs. In 2012, 54 percent of workers lacked access to social security benefits. Altogether, these labor market outcomes reflect an underutilization of Iraq's labor resources.

Rent seeking of Iraq's oil resources is a major contributor to the persisting political and regional disputes, hindering the effective use of oil revenues to address pressing development gaps. Competition for oil and gas production and revenue extraction between different tiers of governments (federal, regional and local) and non-state actors (armed groups) undermines centralized or coordinated oil and gas revenue management. The oil revenue sharing formula does not apply in effect – fiscal transfers to provinces and governorates are uneven and erratic. This prevents lower tiers of government from planning for investment and other expenses. It also incentivizes capture/diversion of oil revenue at source, hampering coordinated fiscal management. Additionally, on four World Bank governance indicators that are relevant to institutional capacity (government effectiveness, regulatory quality, rule of law, and control of corruption), Iraq has the lowest percentile score for each, compared to its peers. Iraq's persistently low score on voice and accountability is also a manifestation of limited transparency on climate change implications for Iraq's present and future, the GoI's performance on mitigation and adaptation actions, and inconsistent support for "bottom-up" and public participation on climate change.

Iraq's economic and development outlook hinges on the implementation of long-awaited reforms, which have lagged primarily due lack of security and due to the complexity of the political economy. These reforms are well known and have been summarized in a number of government plans and strategies, including the 2020 White Paper¹¹ as well as in numerous World Bank studies.¹² The focus of these reforms is to facilitate Iraq's transition from a state-dominated, oil-dependent economy to a diversified, private sector enabling, and market-oriented one. The missing piece in these plans, however, remains connecting Iraq's development to climate action.

1.4. Climate Vulnerabilities and Emissions Profile

Iraq is highly exposed to both the physical and transition risks of climate change. Physical risks are related to the increased frequency and intensity of extreme weather events (drought, floods, sandstorms). According to the World Bank, by 2050, Iraq's average annual mean temperature is expected to rise by 2.5°Celsius and its heat index 35 will increase by 24 days.¹³ The *transition risks* are driven by the pace of a global shift toward a decarbonized world (often called the "energy transition"), wherein oil as a commodity starts to lose its role in fuelling the global economy. According

¹⁰ Informality defined as those in jobs that lack social security coverage.

¹¹ Government of Iraq. The White Paper for Economic Reforms. See <https://gds.gov.iq/iraqs-white-paper-for-economic-reforms-vision-and-key-objectives/>

¹² Including the World Bank's 2020, 2012, and 2006 Country Economic Memorandums (CEMs).

¹³ Heat index 35 is the number of days per year when temperatures rise beyond 35°C.

to projections of the International Energy Agency (IEA), in a net-zero world, oil demand is expected to substantially decline by 2050, impacting all oil producers.¹⁴

Climate variability and extreme weather, coupled with the lack of provision of basic infrastructure services, especially water and electricity, are undermining social stability. In 2021, Mashreq (Iraq, Iran, Lebanon, Syria, Jordan) experienced simultaneously the hottest and driest year of the past four decades. The result was reduced water availability and power supply shortages. During the hottest months of 2021, widespread protests erupted in Iraq, particularly in regions and cities with higher levels of poverty and fewer basic services such as Basrah, Iraq's second-largest city (Loveluck, Fahim, and Dadouch 2021). In recent years, the lack of safe drinking water has become a concern, especially in the south, where saline water mixed with drinking water resulted in illness for thousands of people (HRW 2019). In this regard, 94 percent of respondents to a Country Climate and Development Report social media survey referred to heatwaves and rising temperatures as the climatic disturbances that had created the most challenges for their communities in the preceding five years, 90 percent indicated that their communities are contending with the impact of drought and 83 percent referred to declining water levels. In terms of the likely implications of climate change for social stability and cohesion over the next five years, 72 percent of survey respondents expressed concerns about its debilitating potential to increase community conflict, and 66 percent referred to trepidations about increased displacement perpetuated by climate change. Additionally, more specific testimonies of the impacts of climate change in Iraq is reported in Box 1 by participants in the CCDR focus group discussions.

Box 1. Climate-change-induced water scarcity in Iraq: The testimonies of Iraqi farmers

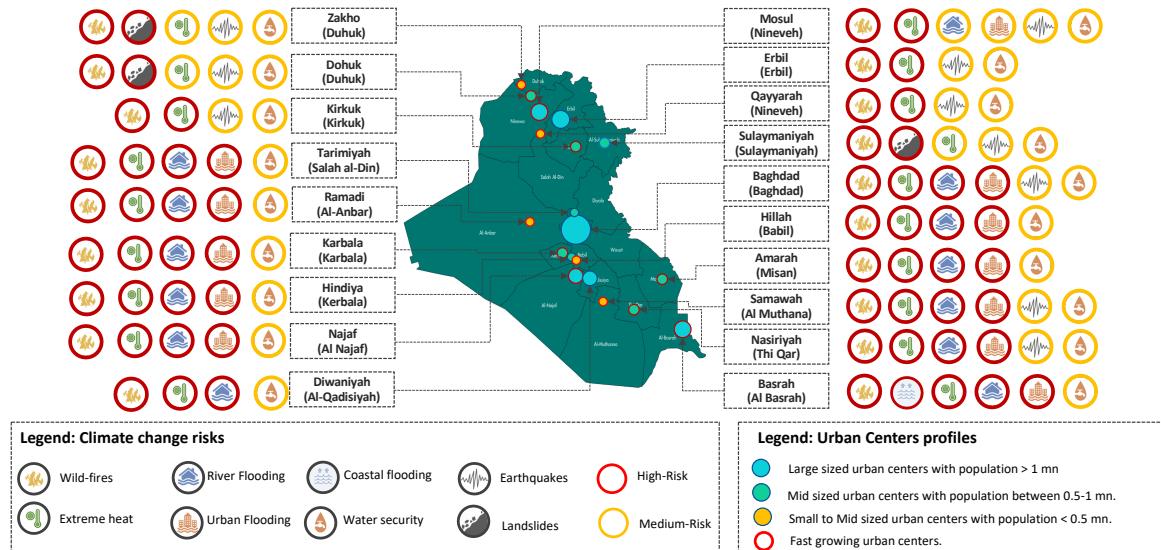
- **Water scarcity and salinity:** ‘Very few people maintained their lands because of the water shortage and land salinity. This impacted the quality of their product which became low as it brings less income to the farmer’.
- **High temperatures:** ‘We used to grow palm dates and cedar trees, but because of the heat waves, and salinity we cannot grow these yields anymore’.
- **Gendered climate impacts:** ‘Women who used to grow Hinna trees and vegetables have stopped their work because of the drought and the increased of heat’.
- **Impact on migration:** ‘The farmers abandoned their land because the level of water in the river declined. They had decided to leave their lands’

Source: CCDR focus group discussions with farmers in Basrah, southern Iraq.

Iraqi cities are susceptible to climate change risks, including floods, droughts, dust storms, and climate-related epidemics. Iraq has suffered from 15 types of disasters that have resulted in a loss of life, property, and significant displacements in the last three decades (Figure 2). For example, 2018 flooding events (flash floods and riverine floods) caused by heavy rainfall severely impacted the cities of Nineveh, Salah ad-Din, Maysan, Wasit, and Basra, affecting an estimated 273,000 people across several central and southern governorates. Cities are the centers of economic and population growth in Iraq.

¹⁴ International Energy Agency. Fuels: Old and New. See <https://www.iea.org/reports/world-energy-outlook-2021/fuels-old-and-new>

Figure 2: Potential climate and natural hazards in cities of Iraq



1.4.1. Iraq's Emissions Profile

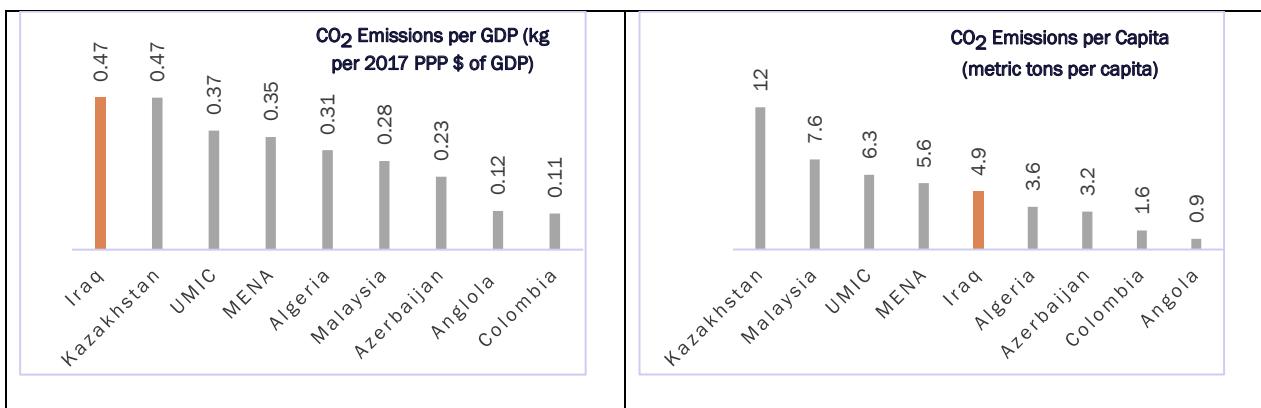
Iraq's carbon emissions have doubled over the last decade alone, driven by population growth and a near doubling of oil production. In 2019, although Iraq represented only 0.45 percent of global greenhouse gas (GHG) emissions, it ranked fourth in MENA.¹⁵ Further, Iraq has one of the highest carbon intensities (emissions per GDP) compared to its peers, based on 2019 data (see Figure 3). In fact, Iraq's emissions growth has outpaced the rate of economic growth. This increase can be attributed to both a steep growth in population—which increased by 21 percent between 2012 and 2018¹⁶—and the associated ramping up of internal oil and natural gas use, particularly in power generation and transport. Production of oil and gas itself also generates significant volumes of GHG emissions from combustion in operations, unabated flaring and venting of natural gas, and leakages of methane along the oil and gas value chain (see Figure 4a).

Almost three-quarters of Iraq's total carbon emissions are attributed to the energy sector. Power generation and fugitive emissions alone are responsible for more than 60 percent of the country's emissions (see Figure 4b). In 2019, more than 98 percent of electricity in Iraq was generated by fossil fuels (55 percent from natural gas and 53 percent from oil). Transport and oil and gas operations come in second place, with almost equal contributions to emissions.

¹⁵ After Iran, Saudi Arabia, and Egypt.

¹⁶ World Bank Open Data.

Figure 3: Iraq's CO₂ emissions per GDP and per capita: A comparative perspective

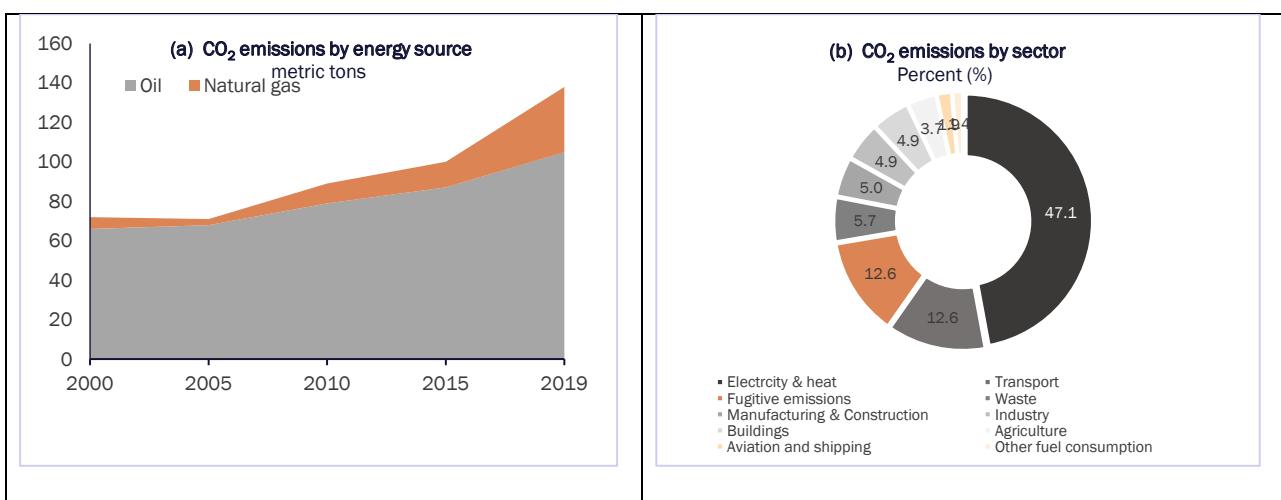


Source: World Bank data, 2019.

Note: UMIC = upper-middle-income country; MENA = Middle East and North Africa.

The growth of emissions from Iraq's electricity sector has exceeded that of electricity output. This “negative divergence” could be explained by the increased reliance on diesel generators in Iraq, since diesel generators have a higher emissions factor compared to utility-scale thermal power generation (Ahmad and Ranade 2021). According to a recent International Finance Corporation (IFC 2019) report, Iraq ranks fifth in the world in the number of diesel generators per capita. In terms of energy demand, it is dominated by nonindustrial end-use consumption. The residential and commercial sectors are responsible for more than 60 percent of the final electricity demand in Iraq. Critical to the issue of fast-growing electricity demand is the presence of deep subsidies. Energy prices are well below the cost-recovery level, particularly for electricity and liquid fuels. In the power sector, Iraq has one of the highest levels of subsidies and unbilled electricity rates in MENA. In 2019, of the 11.3 billion USD total annual operational cost of Iraq's power system, direct fuel subsidies comprised half (5.6 billion USD), leaving the remaining 5.7 billion USD as MoE-related costs. When further accounting for structurally unrecovered losses and other associated commercial losses, 1.3 billion USD was billed to consumers, of which 0.8 billion USD was collected, representing revenues of just 7 percent of total annual system operational costs. After including the cost of fuel subsidies, commercial losses, and theft, around 90 percent of annual operational costs are currently not recovered in Iraq's power system.

Figure 4: Sources and sectoral distribution of Iraq's CO₂ emissions



Sources: IEA and World Bank data, 2019.



2

Iraq's Climate Commitments, Policies, and Capacities



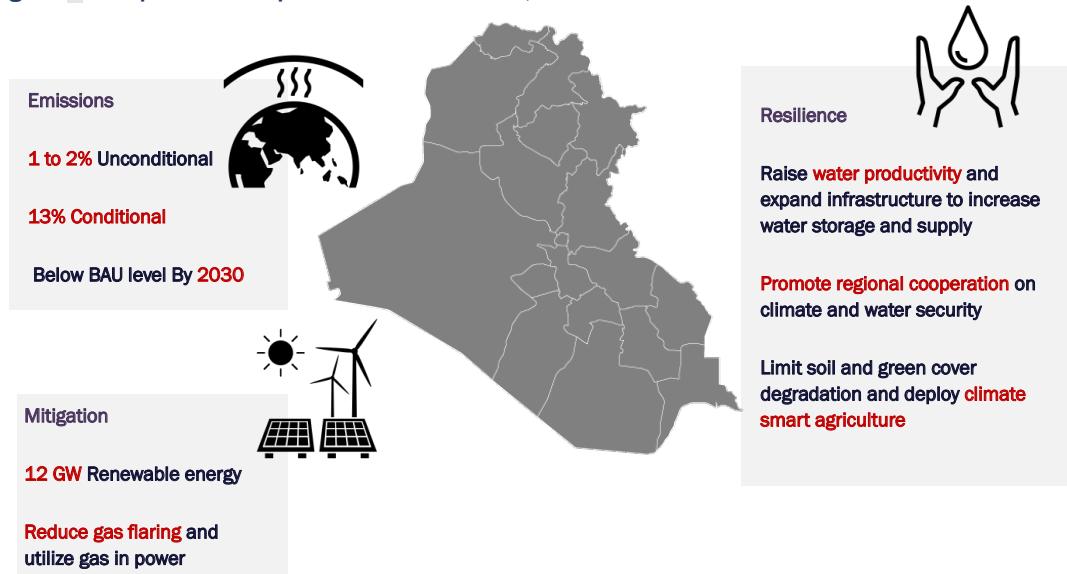
2. Iraq's Climate Commitments, Policies, and Capacities

2.1. Climate Change Commitments and Policies

2.1.1. Decarbonization

Iraq's updated Nationally Determined Contribution (NDC) targets a conditional reduction of GHG emissions by 15 percent by 2030, equivalent to 90 million metric tons of carbon dioxide (MMtCO₂) per year. Between 1 and 2 percent are unconditional, while the remaining 13 percent is conditional on receiving US\$100 billion of financing support and technical assistance (Figure 5) (Iraq NDC 2021). Compared to the 2015 contribution, the main updates to Iraq's 2021 NDC document have been (i) reducing the time frame from 2035 to 2030, and (ii) placing greater emphasis on eliminating gas flaring and on the displacement of high-carbon liquid fuels by natural gas, especially in power generation.

Figure 5: Snapshot of Iraq's NDC commitments, 2021

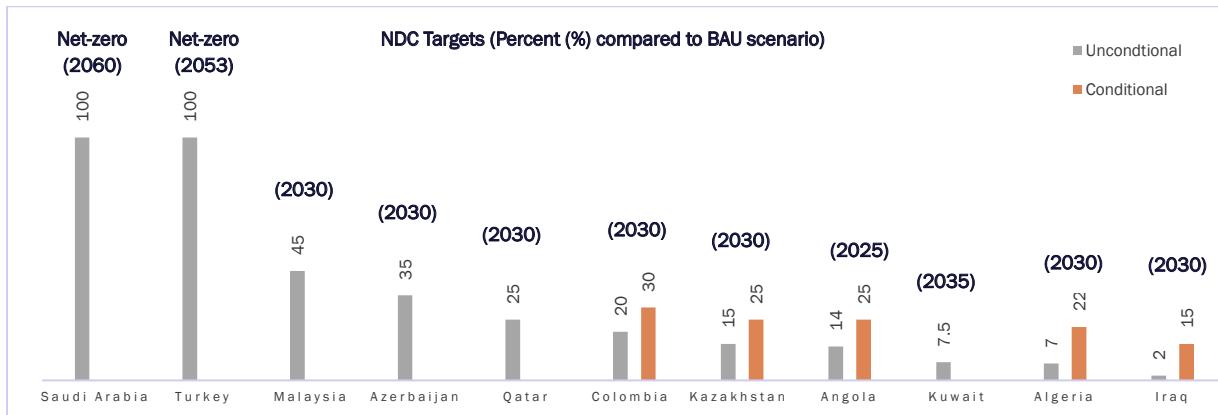


Note: Emissions are relative to 2030 business-as-usual scenario.

Compared to its peers, Iraq's NDC commitments remain modest. The significant development gaps across different sectors are a key limitation to the country's ability to set and achieve more ambitious targets. Even when compared with regional and upper-middle-income peers with similar developmental challenges, Iraq has the lowest level of targeted unconditional emissions reduction contributions (see Figure 6).

Iraq's NDCs places an emphasis on curbing the emissions of the key energy consuming sectors (oil and gas, electricity, and transport). Other sectors, such as non-oil industry, agriculture, solid waste, and the residential sector (wherein energy efficiency measures would be the focus), have also been identified as entry points to lower Iraq's GHG emissions. In the energy sector, Iraq has already started taking steps toward reducing its carbon footprint through measures such as issuing green and smart building codes, passing a solar energy law, and commissioning new power plants that use natural gas as opposed to heavy fuel oil. According to the NDC document, a number of ongoing projects utilize waste-to-energy industrial applications.

Figure 6: Updated NDC targets of Iraq and its regional and income peers



Source: UNFCCC 2021.

Iraq has no shortage of broad decarbonization options. The Iraq NDC document includes an extensive and ambitious list of decarbonization measures, albeit without any analytical assessment of the investment costs and impacts. In 2017, Iraq endorsed the World Bank’s “Zero Routine Flaring by 2030” initiative, committing not to flare associated gas in any new oil fields and to eliminate the practice in existing fields by 2030. In 2018, the Iraqi government approved a new Natural Gas Market Framework,¹⁷ which introduces a contractual and regulatory environment to attract private sector participation and investments in the gas-to-power value chain. Unfortunately, the framework, while approved, was never implemented. Iraq has instead resorted to largely ineffective negotiations of mostly unsolicited proposals from investors, most of which have not evolved beyond letters of intent or memorandums of understanding.

Iraq's Electricity Law encourages the adoption of renewable energy, but implementation has been slow due to institutional capacity challenges. In its fifth article, Electricity Law No. 53 of 2017, which established the Ministry of Electricity also pledges support to “the adoption of renewable energy sources and localizing their technologies” (MOJ 2017). There is also a draft Renewable Energy Law that aims to provide a framework for integrating renewable energy sources into Iraq's energy mix and protecting the environment and mitigating climate change (Al-Maleki 2020). The institutional limitations that are slowing the uptake of renewables are detailed in Section 2.2.

2.1.2. Adaptation

Coping with projected water scarcity and mitigating its impacts on vital economic sectors such as agriculture is the focus of the adaptation narrative of Iraq's NDC document. The primary adaptation actions are related to improving water resources management through (i) sustainable utilization of groundwater, (ii) water harvesting, and (iii) the use of modern technologies in monitoring and controlling groundwater aquifers. Additionally, Iraq's NDCs emphasize the role of new infrastructure projects in helping to increase water supply, such as renewable energy-powered seawater desalination, commissioning of dams, and underground reservoirs to collect water and mitigate flood risks. The Iraq NDCs also highlight the importance of raising the efficiency of irrigation water use according to the nature of crops and soil. Besides water scarcity, the NDCs discuss reducing and rehabilitating soil degradation, increasing vegetation cover, improving land management practices, and adopting climate-smart agriculture.

¹⁷ Resolution No. 51 of 2018.

Implementation of the Strategy for Water and Land Resources of Iraq (SWLRI) had envisioned spending US\$175 billion in the sector over a 20-year period, but the financing did not materialize as expected. A significant drop in oil prices in 2015, coupled with the expensive fight against and reconstruction needed after insurgency, decimated the Iraqi budget. The COVID-19 pandemic has worsened the situation with further oil revenue fluctuations and a halt in water tariff collection.

A strong agri-food sector is acknowledged as a critical element of a diversified economy that can also serve to reduce poverty. Under the economic development plan for 2013–17, agriculture was identified as one of five sectors of focus for investment intended to diversify sources of growth as well as reduce economic inequality between urban and rural areas of the country. The National Development Plan 2018–22 set out four objectives for the agriculture and water resources sector, including a targeted increase in the contribution of agriculture to GDP from 4.5 percent in 2015 to 5.2 percent in 2022; and raising the growth rate of the sector to 8.4 percent annually. Iraq's second Poverty Reduction Strategy 2018–22 aimed to reduce poverty including through the promotion of income generation from agriculture projects. These projects have a particular focus on women in rural areas. The government's White Paper for Economic Reforms prioritizes agri-food sector interventions for diversification and recovery.

Iraq lacks urban planning policies and has a low predictive capacity for natural disasters, including climatic ones; its post-disaster response is often conducted on an ad hoc basis. With the projected increase in the frequency, intensity, and unpredictability of extreme weather events, the presence of such schemes is more urgent than ever. Additionally, extreme weather events such as floods are a major cause of internal migration and disruptions to basic services such as electricity, water, and telecommunications. This disruption potential makes it necessary to set up (i) sector-specific resilience plans, (ii) coordination among various governmental entities, and (iii) budgetary allocations to disaster response and management.

2.2. Institutions, Financial Markets, and the Private Sector's Readiness

Iraq's plans for development and for addressing climate change—as seen in the White Paper and the NDC document—are not aligned, reflecting capacity constraints. The lack of integration and coordination between development priorities and climate actions is evident in the absence of any direct and substantial mention of climate change, its effects, or opportunities, in Iraq's major development frameworks such as the White Paper (2020), Vision 2030 (2019), and the National Development Plan (2018), despite the well-known climate change risks in Iraq. There is also a notable lack of clarity regarding roles and messaging on climate change implications and action. Responses to the March 2022 social media survey on climate change attest to the growing need to clarify institutional roles and responsibilities with regards to climate change. About 27.2 percent of survey respondents¹⁸ either disagreed with the statement that the government is taking steps to deal with climate change and its impacts in Iraq, or they were simply unaware of any such actions or did not believe that they are relevant. Although 80 and 79 percent of respondents indicated that citizens and corporations should do more to address climate change, higher percentages of respondents deemed that government entities (president/prime minister, local officials, council of ministers, etc.) should be doing more to address climate change. Similar opinions were echoed during focus group discussions convened with representatives from civil society and academia, as well as oil workers and agricultural workers.

Climate change challenges will test the effective functioning of government as a whole, including capacities at the governorate level that are already stretched by instability and fragility. At the executive branch level, Iraq needs to prioritize its human and institutional capacity, especially from the

¹⁸ There were approximately 2,300 responses to the survey.

perspective of policy, planning, regulatory oversight, and public finance resilience. However, the effects of climate change will vary across governorates, which have different development priorities, climatic zones, and economic and demographic profiles. In the event of a shock, local capacities are the first to be tested and required to respond.

The development of Iraq's financial sector and its effective contribution to economic growth have been persistently challenged. The financial sector is dominated by state-owned banks and falls short in its role of allocating scarce resources effectively within the economy. State-owned banks are primarily geared to provide financing to the public sector entities and support quasi-fiscal financing directed at supporting state-owned enterprises (SOEs). Private banks are also not an effective conduit for financial intermediation and economic diversification, on account of their lack of know-how of advanced banking operations and products, weak balance sheets, and inherent asset-liability mismatches which preclude them from offering long-term financing products in support of infrastructure development projects. Consequently, the role of the banking system in intermediating credit to the economy remains small, with personal sector credit accounting for only 8.7 percent of GDP and thus not meeting its potential as an engine for economic growth and inclusion.

The overarching role of the state in Iraq's financial sector has in effect crowded out the private sector. Decades of state control (both direct and indirect, through SOEs) have undermined the private sector, as have the security situation, poor governance, elite capture, knowledge gaps, limited access to finance, shortages of skilled labor, and a difficult regulatory environment (World Bank 2021c). To that end, Iraq's private sector is dominated by small and self-run or family enterprises, with low levels of productivity (ILO 2021). Additionally, these firms' potential in playing a bigger role in Iraq's green transition is constrained by harmful practices such as double-book accounting, undermining the ability of local and foreign investors to properly appraise the viability of private sector projects and make informed investments decisions.



3

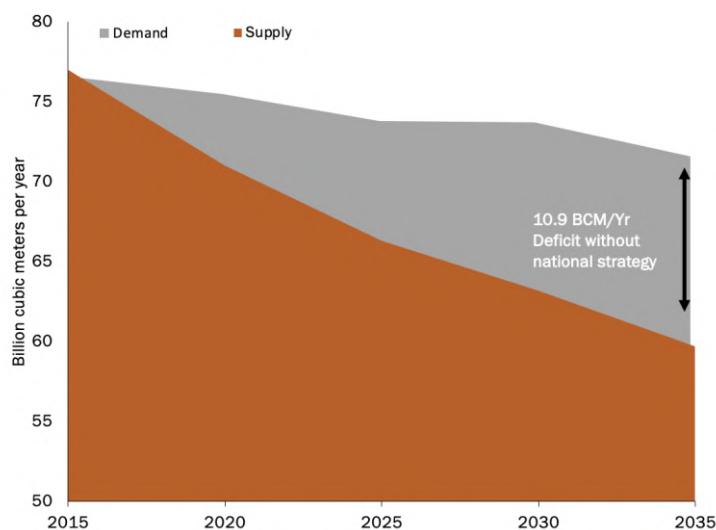
The Impacts of Water Scarcity

3. The Impacts of Water Scarcity

3.1. Iraq's Water and Agri-Food Realities

Iraq is quickly running out of water, and without policy action, the gap between water supply and demand in Iraq is widening and expected to reach about 10.9 billion cubic meters by 2035. Water resources in Iraq are under increasing pressure due to population growth, economic development, increasing withdrawal from riparian countries, and climate change. According to the SWLRI, the combined effects of temperature increase by 1 degree Celsius and precipitation decrease of 10 percent is estimated to cause a 20 percent reduction of available freshwater (World Bank 2021a). Such a dramatic decrease in water availability would be a threat to the country's economic diversification, green growth, and job creation ambitions since it would deprive nearly one-third of the irrigated land in Iraq of water in a BAU scenario.

Figure 7: Variation of water demand and supply in Iraq without national strategy



Source: Based on Fig. 18 Iraq's CEM, fall 2021.

Iraq's water security is further challenged by its dependence on transboundary water flow from neighboring countries, which are also facing increased water stresses driven by climate change. Iraq is a downstream country, with about 60 percent of its total renewable water resources being generated outside its borders (from Turkey, Iran, and Syria), primarily through the Tigris and Euphrates rivers. Consequently, Iraq will also be affected by climate change impacts in these countries, which will have significant implications for its water security. The flow (or discharge) rates of Iraq's major surface water sources, the Tigris and Euphrates, have been declining over the last few decades due to increased water use in the upstream countries. Since 1999, the Euphrates shows below-average discharge at Jarablus, Syria and at Hussaybah in Iraq, possibly reflecting a combination of drier weather conditions and the effects of extensive dam building (UN-ESCWA and BGR 2013).

In addition to water scarcity, Iraq faces the challenge of water quality degradation. Water salinity and pollution related to municipal, industrial, and agricultural activities are two major concerns in Iraq. Most of the soil salinization observed in central and southern Iraq stems from the use of irrigation water with high salt content. Limited drainage mechanisms and high evaporation rates cause salts to accumulate

in irrigated agricultural land. Regarding the pollution, only 10 out of 18 governorates have wastewater treatment facilities.

Without intervention, water scarcity and suboptimal water quality are significant risks to Iraq's agri-food systems. As highlighted in the focus group discussion with farmers, declining soil fertility, high soil salinity, erosion, and the extension of sand dunes are pervasive problems for Iraqi agriculture, forcing many Iraqis to abandon their land. Irrigation plays a significant role in crop production in Iraq, and any substantial reduction in water supply could harm agricultural production. The share of agriculture in annual freshwater withdrawal for Iraq is about 79 percent (SWLRI), while water scarcity is increasing due to rising water demand, reduced runoff, and decreased transboundary water flows. Crop production in Iraq relies on irrigation due to the low productivity of rainfed cropping. The share of irrigated area in total harvested area in Iraq was about 91 percent in 2016, while the share of irrigated crops in total crop production was 94 percent (World Bank 2020b).

The agriculture sector is important to Iraq's economy and its food security. In 2020, the sector's share of the GDP was 5.9 percent in Iraq, which is slightly above the average of 5.2 percent for MENA and employs approximately 9 percent of workers. The broader agri-food sector contributes a higher percentage of GDP when related value chain activities are counted. However, agriculture in Iraq is largely practiced on small farms and is more likely to follow out-of-date agricultural practices, decreasing resilience to climate-related and other shocks. More than 80 percent of farms measure less than 10 hectares in total area, with nonadjacent plots. The sector is also important for ensuring food security, noting that Iraq has one of the largest government-run food programs in the world. Reliance on food imports, exacerbated by the COVID-19 pandemic and most recent commodity price spikes due to the war in Ukraine, are important risk factors.

3.2. The Economic Impacts of Decreased Water Availability and Crop Yield

To analyze the impact of water scarcity, a range of alternative scenarios that portray Iraq's economy under different water scarcity scenarios mixed with climate impacts on crop yields and scenarios were developed and analyzed (using multiregional global computable general equilibrium model, known as GTAP-BIO-W. More details about the GTAP-BIO-W can be found in World Bank 2020b). The simulations include six scenarios, of which three are presented in this report:

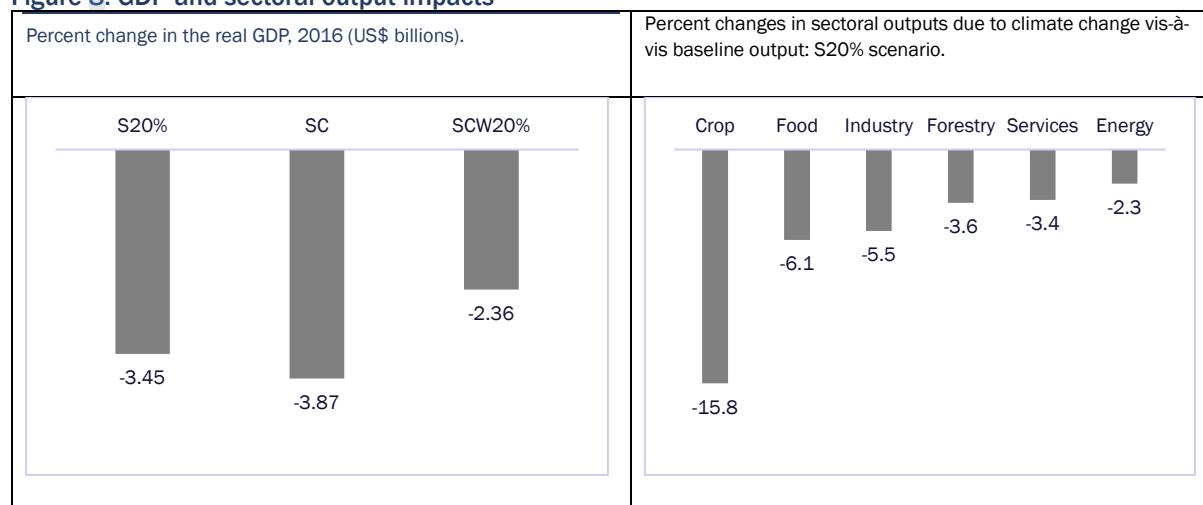
- Scenario 1 (**S20%**): 20 percent reduction in water supply
- Scenario 2 (**SC**): 20 percent reduction in water supply and temperature impacts on crop yield
- Scenario 3 (**SCW20%**): 20 percent reduction in water supply and temperature impacts on crop yield and 20 percent improvements in water use efficiency (WUE)

In Iraq, water availability may decline by up to 20 percent by 2050 due to climate change (SWLRI). The projected decline ranges from 13 percent to 28 percent depending on which climate model output and scenario are considered (World Bank 2020b). While rainfall has declined in Iraq, crop production has increased. The expansion in crop production was usually made possible through irrigation expansion and improvements in production technology. However, this expansion has led to increased overuse of groundwater. Thus, the country will experience major constraints to maintain or expand crop production in the future. Iraq has already exploited its water resources intensively, it has passed the sustainable water withdrawal level, and is currently facing water deficits.

Increased temperatures will negatively affect crop yields in the Middle East, and Iraq is among the countries that are expected to experience more negative impacts than most. According to the Water in the Balance report, temperature increase negatively affects some crops, particularly wheat (-24.8 percent) and coarse grains (-24 percent); and in general, irrigated crops are less impacted by projected temperature increases.

Declines in water availability and crops yield are expected to have a substantial negative impact on GDP, but improvement in WUE would mitigate some of the effects. The larger the magnitude of water supply reduction, the higher the rate of reduction in GDP^{Figure 8}. Improving WUE, however, would offset some GDP losses, and thus help mitigate adverse climate change impacts. Iraq's GDP is projected to drop by 3.5 percent under a 20 percent reduction in water supply, and by 3.9 percent when higher temperatures are factored in (Figure 8). The projected reduction in GDP shrinks to 2.4 percent, however, with improvements in WUE.

Figure 8: GDP and sectoral output impacts



Source: World Bank 2020b.

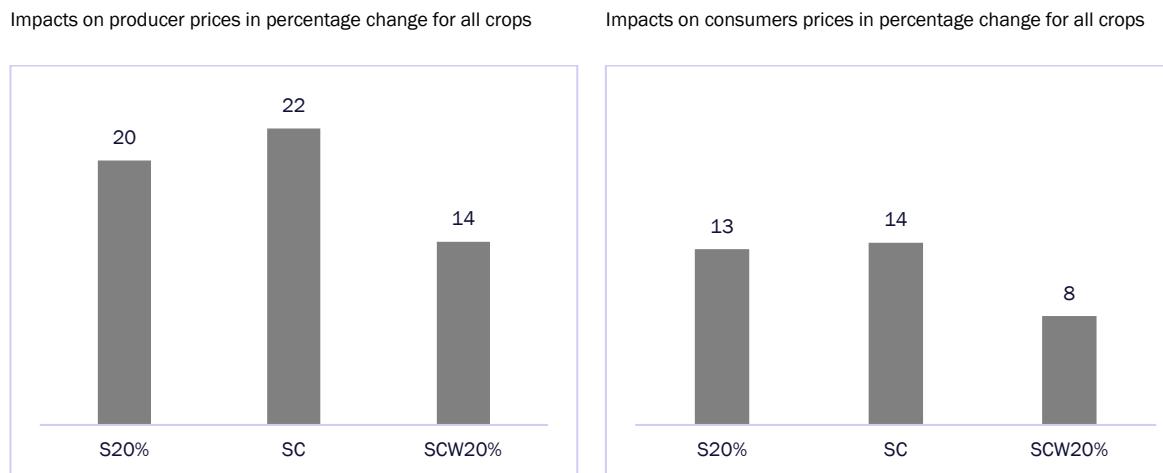
The analysis of climate change impacts shows negative impacts in all sectoral outputs, whether directly or indirectly. The analysis was conducted for the scenario S20% and impacts assessed on economic activities aggregated into six categories: Crop, including all crop sectors; Forestry; Food, covering all food sectors including livestock; Energy, including coal, oil and oil products, Gas and Electricity; Industry, covering all industrial sectors; and Service, including all types of services. Crop production drops significantly while food production drops at a lesser rate because of imports of crops and food products (see Figure 8).

The effects of water scarcity will render a portion of existing capital in agricultural and nonagricultural activities idle. When water availability and crop yields decline, the existing capital in both agricultural activities and non-agricultural activities (with linkages to agricultural activities) will not operate at full capacity. In the SC scenario, the change in idle capital is 11.22 percent in agricultural activities and -3.89 percent on nonagricultural activities. This increase in idle capital will worsen the current suboptimal operation and efficiency of infrastructure. As for the scale of the impact of climate change on jobs and livelihoods, this is discussed in Chapter 6 below.

Water scarcity and temperature impacts on crop yields will increase producer and consumer prices and possibly food imports but improving WUE could offset a portion of these impacts. The poor will be the most impacted by price increases as they spend a higher share of their household budget on food and are more at risk of food insecurity (Figure 9). Estimates indicate that a 10-20 percent increase in food prices would increase poverty by 1.6 to 4.4 percentage points. Iraq will need to rely more on food

imports to preserve national food security, given the projected losses in food output under climate change effects. Production of crops, livestock and livestock products, and processed food and feed are all expected to fall more than consumption in each of these categories, requiring imports to fill the widening gap between production and consumption. Because Iraq is a net importer of agricultural and food products, increasing imports will generate a negative terms of trade effect. By contrast, countries that export these products will be able to transfer a portion of the price impacts of climate change to foreign consumers, and for countries that export valuable agricultural products (vegetables and fruits) and import low-value crops, they will experience a positive terms of trade effect.

Figure 9: Impacts on producers and consumers prices



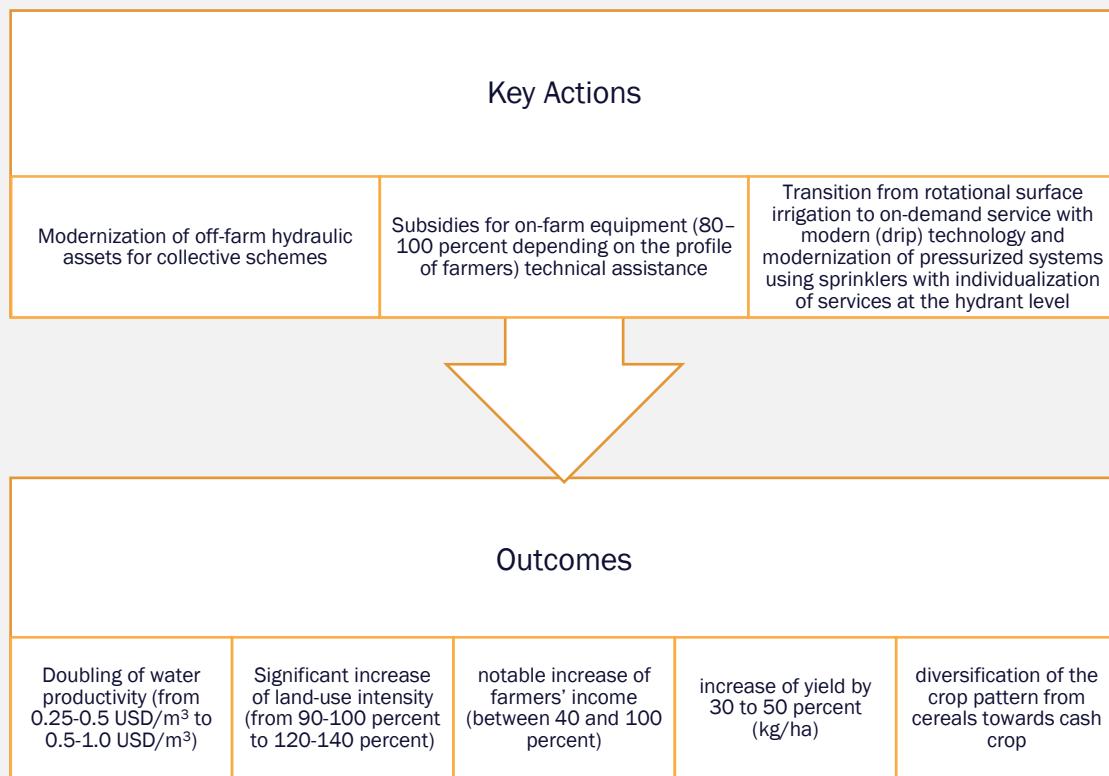
Source: World Bank 2020b.

To mitigate some of the causes and effects of water scarcity, including those driven by climate change, a total investment package of around US\$70 billion has been identified. This package covers an optimal mix of actions called for under the US\$ 175 billion SWLRI. The recommended CCDR policy levers prioritize (i) the rehabilitation of hydraulic infrastructure, irrigation, and drainage (to manage the salinity), and (ii) water and agriculture non-infrastructure actions. More details about those proposed interventions can be found in Chapter 7.

Of fundamental concern for the population of Iraq is that as water scarcity and temperature impacts on crop yields drag down GDP, the smaller available fiscal space to subsidize food through the public distribution system could negatively impact poverty and food security if no other social protection systems are in place.

Box 2. Morocco Doubling Water Productivity with Irrigation Modernization

As a response to increasing water scarcity and interannual variability, Morocco launched, in 2008, the National Program for Water Savings in Agriculture (*Programme National d'Economie d'Eau en Irrigation*, PNEEI). The PNEEI program of on-farm modernization aimed at increasing water productivity and improving irrigation delivery services, as part of the Green Morocco Plan, the sectoral strategy for the 2008–2019 period. The actions and outcomes of this sectoral intervention are outlined as follows:



After twelve years of implementation of the PNEEI, farmers benefitted from a doubling of the water productivity. This productivity increase did not lead systematically to a reduction in the consumption of irrigation water at farm level because farmers tend to maximize their use of the means of production and intensify toward crops production with higher added value. Complementary Water Conservation Policies (pricing, quotas) need to be implemented in parallel to the modernization to maintain water withdrawals at a sustainable level and cope with interannual variability.

The background image shows a massive industrial flame or gas flare at sunset. The fire is bright orange and yellow, casting a warm glow over the scene. In the foreground, the silhouette of a person's head and shoulders is visible on the right. A vertical color bar with a gradient from red to blue is positioned on the far left.

4

Energy Sector Decarbonization as a Driver of Improved Service Provision and Efficiency

4. Energy Sector Decarbonization as a Driver of Improved Service Provision and Efficiency

4.1. The Benefits of Addressing Emissions Along the Oil and Gas Value Chain

Iraq holds 145 billion barrels of proven oil reserves, the fifth-largest holding in the world, equivalent to 96 years' worth of production at the current rate. The country produced a peak of 4.8 million barrels of oil per day (MMbbl/d) in 2019. At about US\$10.60 per barrel, Iraq's production costs are very low against those of other large producers. However, the carbon intensity of its oil production, at 31 kilograms of carbon dioxide (kgCO₂) per barrel of oil equivalent,¹⁹ is significantly higher than the world's average of 18 kgCO₂.²⁰

Iraqi government announcements point to a significant increase in oil production in the next five years, with a target of 8 MMbbl/d by 2027. However, world demand for oil and Organization of the Petroleum Exporting Countries (OPEC) quotas are likely to limit actual output. Recent projections indicate that world demand will reach a peak of around 106 MMbbl/d by 2040, falling thereafter.²¹ OPEC's share of world production stood at 35.2 percent in 2020, of which Iraq produced 13.2 percent, and OPEC's share is projected to surpass 40 percent by 2040.²² Iraq's cost of production, the lowest after Saudi Arabia's, is expected to place Iraq in an advantageous position to continue to gradually increase its OPEC quota from 13.2 percent in 2020 to 15 percent by 2030 as long as the carbon intensity of its exports is addressed. The high carbon intensity of Iraqi oil might impact its carbon-competitiveness in export markets that adopt carbon taxes or carbon border adjustment mechanisms, thus impacting oil revenues and the country's ability to ramp up its oil production. Given these factors and projected trends in world demand, and the share of OPEC's participation, we estimate Iraq's oil production to reach 5.8 MMbbl/d by 2030 and 6.4 MMbbl/d by 2040.

The production of associated natural gas is expected to increase in tandem with oil production. Consistent with the elimination of routine flaring by 2030, the supply of dry natural gas is expected to increase gradually from 1 billion standard cubic feet per day in 2020 to 1.87 Bscfd in 2025 and 2.88 Bscfd in 2030 (see Figure 10).

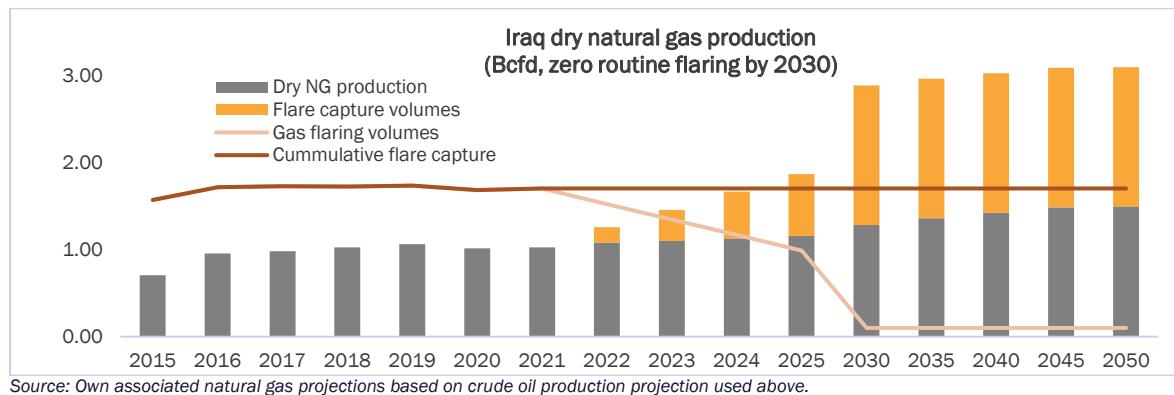
¹⁹ Rystad Energy research and analysis, Emissions Solution.

²⁰ The United States' 12 kgCO₂, Saudi Arabia's 10 kgCO₂, and Norway's and the United Arab Emirates' 7 kgCO₂ per barrel of oil equivalent provide an international target reference.

²¹ The U.S. Energy Information Administration and OPEC forecast world demand to reach a peak of 96 and 109 MMbbl/d by 2045, respectively, and falling thereafter.

²² According to the IEA, "shortfalls in investment, which cannot be ruled out even in lower demand scenarios such as the APS and NZE, would likewise be disruptive,... and the share of OPEC members and Russia in oil production rises from 47% in 2020 to 58% in 2050 in the APS, and to 61% in the NZE, comparable to the highest level in the history of oil markets in the 1970s."

Figure 10: Projections of Iraq's dry natural gas production (Bscfd, zero routine flaring by 2030)

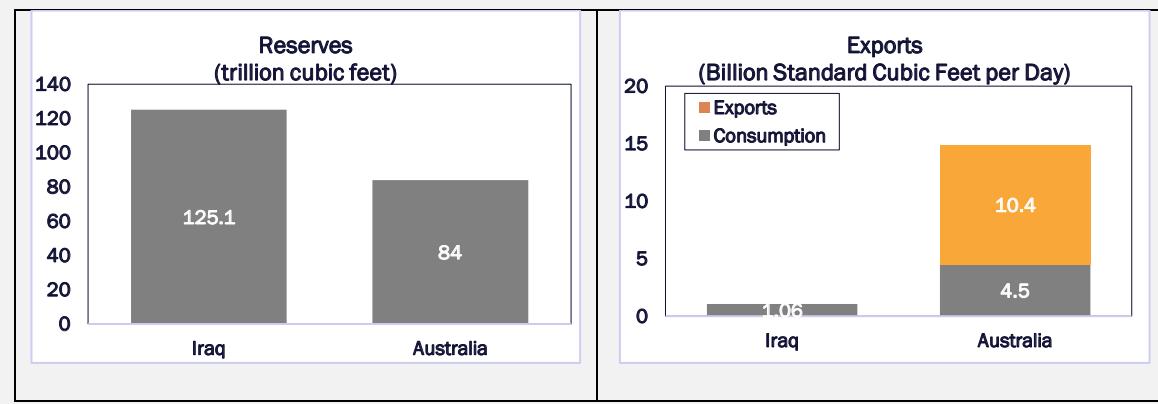


4.1.1. Gas Flaring from Waste to Resource

In the last decade, Iraq witnessed a rapid growth in production of associated natural gas due to an increase in oil production. In 2009 Iraq produced 1.7 Bscfd of natural gas; by 2016 production had reached 2.8 Bscfd. Current production of natural gas, however, is still low considering the size of Iraq's proven natural gas reserves (125.1 trillion cubic feet), equivalent to 336 years' worth of consumption at the current rate. For the sake of comparison, see Box 2 that shows the huge underutilization of Iraqi gas compared to Australia, a country with much lower reserves.

Box 3. Comparing Iraq and Australia's Economic Utilization of Natural Gas

Australia, with significantly smaller proven reserves (84.4 trillion cubic feet), produced 14.9 billion standard cubic feet per day (Bscfd) in 2019 and exported 10.4 Bscfd of liquefied natural gas—second only to Qatar with 10.1 Bscfd—for an estimated export value of \$32 billion.

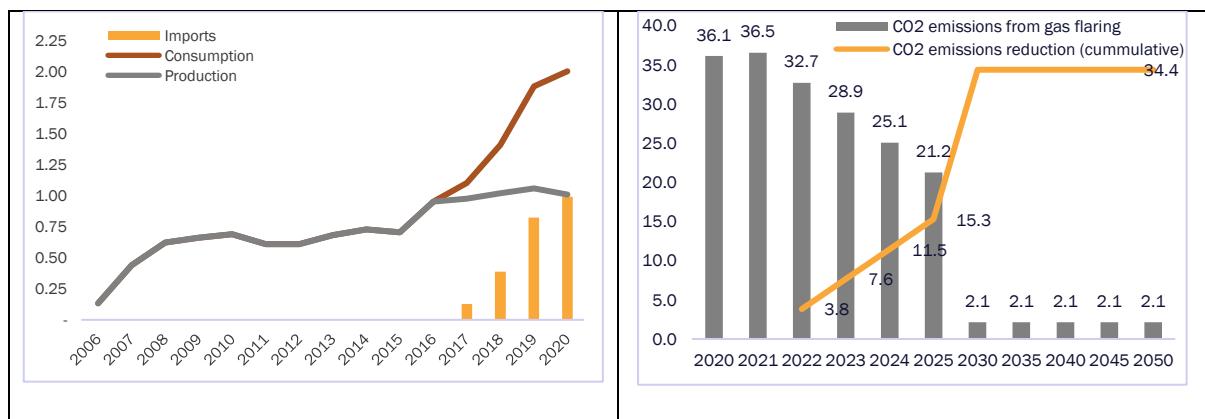


Iraq's flared gas is worth US\$2.5 billion in approximate annual value and is sufficient to fuel 10 gigawatts (GW) of much needed electricity generation capacity. Iraq remains the second-largest gas-flaring country in the world, after Russia. It flares 1.7 Bscfd of associated natural gas while importing up to 1 Bscfd from Iran to use for power generation. Iraq's gas flaring accounts for 12 percent of the world's total, and is equivalent to 35.8 MMtCO₂ per year (BP 2022). Processed or dry commercial-quality natural gas production has lagged behind consumption needs for power generation, with rapidly increasing imports closing the gap since 2017, at significant cost (see Figure 11). According to 2018

5-Year Gas-to-Power Action Plan for Iraq prepared by the World Bank Group,²³ approximately \$44 billion of investment along the gas-to-power value chain will be required to address the flaring, processing, and transport of domestic natural gas for power generation needs. Assuming Iraq complies with its endorsement of the World Bank Zero Routine Flaring by 2030 initiative, flaring volumes should decline gradually from 1.7 Bscfd in 2021 to 0.1 Bscfd in 2030. Associated emissions of CO₂ would decline in tandem, from 36.5 MMtCO₂ in 2021 to 2.1 MMtCO₂ in 2030 (see Figure 11).

In June 2021, IFC became the lead arranger of a \$360 million loan to Basrah Gas Company (BGC), a joint venture between Iraq's state-owned South Gas Company, Shell and Mitsubishi Corporation. The investments include a \$138 million loan from IFC's own account. The loan provides support to develop a processing plant to treat and process associated gas that would otherwise be flared. IFC's investment in Iraq's BGC supports one of the largest gas flaring reduction projects in the world and is helping to improve energy access, prevent associated GHG emissions and support a more resilient, sustainable energy sector in the country. The expansion that IFC is financing will contribute to reducing GHG emissions by about 9 million tons of CO₂ (mmtCO₂) per year and 45 million tons of hydrogen sulfide. BGC as a whole is expected to increase its processing capacity, thereby avoiding more unnecessary flaring and associated GHG emissions by around 30 million tons per year.

Figure 11: (a) Dry natural gas production, imports, and consumption in Iraq, 2006–20 (Bcf/d); (b) Projected CO₂ emissions from gas flaring in Iraq, 2020–50 (million tons/year)



In addition, the other way of reducing natural gas flaring is to attract investors to utilize it in downstream chemicals production. Large amounts of associated gas can be utilized as a cost-effective feed for downstream chemicals, mainly methane (C1), ethane (C2), and propane (C3). Although its natural gas condensate has a high ethane content, only an extremely limited volume of ethylene is produced.²⁴ In 2019 alone, Iraq imported around US\$6 billion worth of refined petroleum, plastics, fertilizers, pharmaceuticals, and other key chemical-based products. To crowd-in private investment, as well as enhance the competitiveness of the downstream chemical industry, Iraq needs to introduce policies for transparent, internationally-benchmarked pricing of natural gas used as feedstock for downstream industries and as fuel for power generation.

²³ Prepared with World Bank support and submitted to the GoI in March 2018.

²⁴ Ethylene is a feedstock for an array of other products, among others polystyrene, ABS plastics, PVC plastics, polyethylene, ethyl alcohol, solvents, and many more.

4.1.2. Addressing Methane Abatement in Oil and Gas Operations (by 2030)

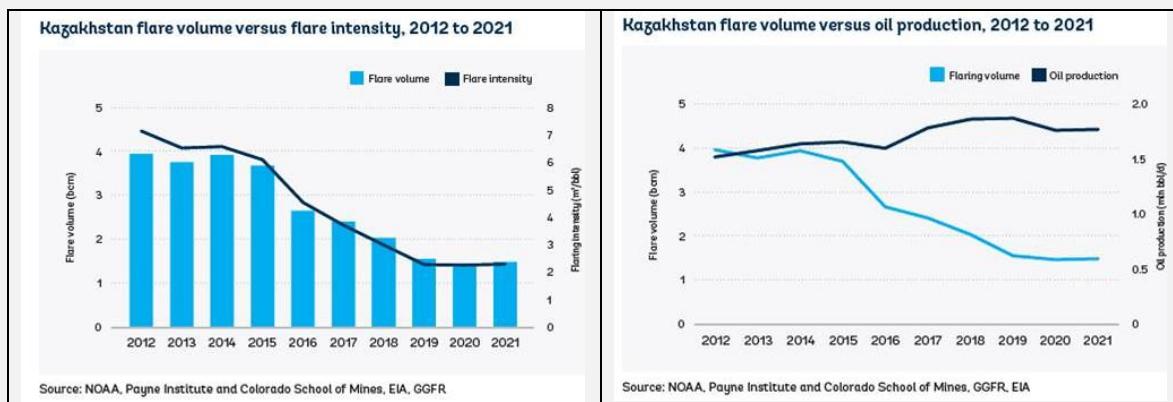
Addressing methane emissions along the oil and gas value chain is a cost-effective, short- to medium term intervention to meet Iraq's NDC commitments. Iraq's oil and gas sector operations are estimated by the IEA to have generated slightly more than 2.8 Mt of methane emissions in 2020, roughly equivalent to 84 metric tons of carbon dioxide equivalent (MtCO₂e), of which oil production accounts for 95 percent. Vented methane accounted for 55 percent of total methane emissions, and incomplete flaring of natural gas for more than 38 percent of the total, with the balance represented by fugitive emissions and other smaller sources.²⁵ Reducing methane from oil and gas operations, along with the abatement of CO₂ emissions from operations, is particularly promising because more than 70 percent of CH₄ emissions can be abated with existing technologies. In addition, the cost of mitigation is often lower than the market value of the gas that is captured. Based on average natural gas prices from 2017 to 2021, the IEA estimates that almost 45 percent of oil and gas methane emissions can be avoided with measures that would come at no or negative net cost. Methane abatement actions tend to fall on the lower end of the cost curve. Effective established policies include leak detection and repair (LDAR) requirements for fugitive sources, equipment mandates for sources known to emit significant volumes of methane, and measures designed to limit nonemergency flaring and venting, including energy efficiency measures, electrification and integration of renewable energy in operations, displacement of high-carbon fuels with low-carbon heat and power processes, improved O&M protocols, and CCS.

Beyond 2030, investing in carbon capture, utilization, and storage (CCS) and low-carbon hydrogen (LCH) can ensure Iraq's gas-fired power generation does not result in GHG lock-in and/or stranded assets in the long term. Supporting climate mitigation and development while reducing lock-in risks and risks of stranded assets, including energy resources, is particularly important in fossil fuel dependent economies such as Iraq. CCUS and LCH are two of few options that will maintain the value of these resources in a low-carbon future. Global evidence suggests that developing CO₂ transport and storage networks for industrial CCUS hubs can reduce unit costs through economies of scale and facilitate investment in CO₂ capture facilities. To accelerate the adoption of CCUS, Iraq could establish markets for premium lower-carbon materials – such as cement, steel, and chemicals – by ensuring access to public and private procurement.

²⁵ Upstream includes all emissions from production and gathering and processing; downstream includes emissions from refining, transmission, and distribution.

Box 4. Kazakhstan: A Remarkable Gas Flaring Reduction Journey

Kazakhstan has achieved a remarkable reduction in both the volume of flared gas and in flaring intensity. Flared volumes fell from 4 bcm in 2012 to 1.5 bcm in 2021, or 59 percent, and flaring intensity fell at an even faster rate, from 7.2 m³ to 2.3 m³ per barrel of crude oil produced, equivalent to a 62 percent reduction; this while oil production increased by 16 percent.



Kazakhstan has undertaken substantial policy reforms to achieve that goal. These reforms significantly align with- and adopt a number of features that have been found to be effective and conducive to similar successes elsewhere, namely:

- **Legal framework:** Adoption of a Petroleum Law that explicitly prohibits gas flaring. Kazakhstan approved a new Law in 2017. The Environmental Code, of 2021 requires entities responsible for gaseous emissions to obtain a permit and introduces the concept of an integrated environmental permit.
- **Regulatory framework:** Regulatory authority is vested on a largely independent sector regulator, with coordinated oversight with the environmental regulator. Flaring of associated gas and the emissions associated with flaring are regulated at the national level. Kazakhstan's Ministry of Ecology, Geology, and Natural Resources (MEGNR) is the environmental regulator and has jurisdiction over flaring emissions. Regulations are issued by the regulator, including rules for technical evaluation and exploration and production contracts.
- **Development Plans:** The Law requires field development plans to specifically include a section on raw gas processing and utilization.
- **Authorized flaring:** Flaring under all circumstances requires a permit. Applications for a permit to flare raw gas can be submitted online. Operators pay royalties or penalties on flared, vented, or otherwise wasted gas unless an exception is obtained from the regulator.
- **Ownership rights:** While retaining state ownership over natural gas resources and production, contracts grant operators rights to oil and gas production over the volumes remaining once royalties or state profit shares in production sharing contracts have been paid in kind. Companies can dispose of oil and gas production freely by negotiating with buyers in local or international markets.
- **Rigorous monitoring:** The Law requires measurement of emissions to ensure compliance under approved metering methodologies, daily reporting of associated gas production and monthly reporting of volumes of associated and natural gas used, lost, marketed, re-injected, or flared.

4.2. Decarbonizing the Power Sector

With a near-complete reliance on oil and gas to generate power, almost half of Iraq's emissions are linked to power generation (Figure 4b). In 2019, more than 98 percent of electricity in Iraq was generated by fossil fuels (55 percent from natural gas and 43 percent from oil). The Iraqi power sector is characterized by a number of significant inefficiencies, which are well documented and observed (gas flaring, high use of liquid fuels, high grid losses, and low cost recovery).

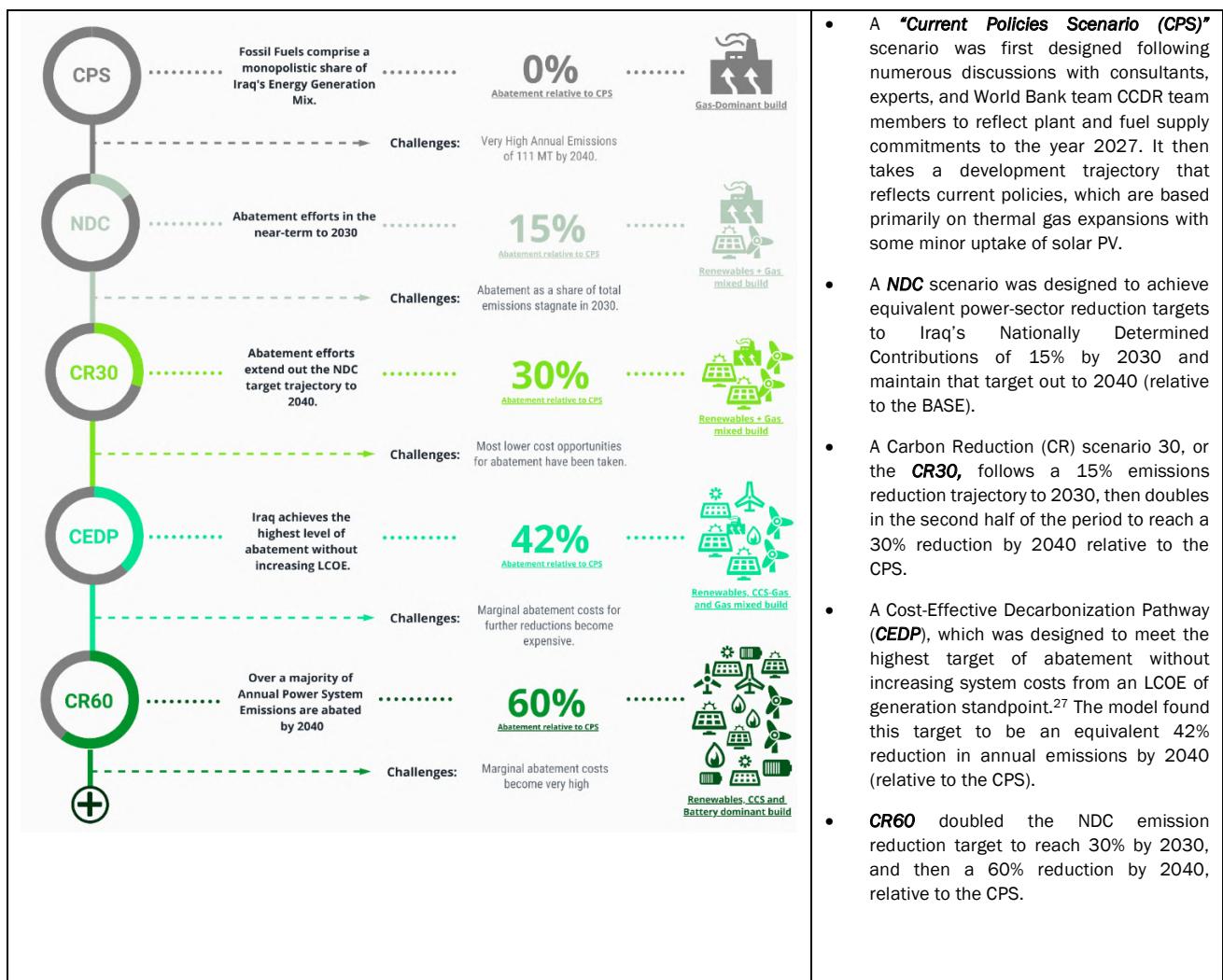
Reversing the power sector's inefficiencies will not only result in achieving substantial reductions in emissions but also contribute to other development objectives. Addressing Iraq's significant inefficiencies would serve to lower economic costs (i.e., the fiscal pressure of the sector) and end-user prices connected with the use of diesel generators, improve reliability and the business environment, and mitigate the public health effects due of having diesel generators close to population centers. Decarbonizing power generation will require an aggressive integration of renewable energy resources and, in the short to medium term, the displacement of higher-carbon, imported liquid fuel sources by domestic natural gas. The sections that follow summarize key results of each scenario simulated in the World Bank's Electricity Planning Model (EPM) for Iraq.

4.2.1. Designing Feasible Pathways to Decarbonize Power Generation

The World Bank's EPM was used to analyze least-cost power generation trajectories in Iraq over the 2021–40 period.²⁶ Five primary scenarios were designed to assess the most feasible decarbonization pathway for the electricity sector, first with the short-term goal of closing the significant supply-demand gap by 2024 and then exploring multiple carbon reduction pathways over the 2025–40 horizon. A cross-scenario modelling analysis was carried out to highlight key economic differences in planning outlook results. The examined scenarios are summarized in Figure 12.

²⁶ A 2021–40 modelling horizon was taken due to the availability of input data, government policies, and longer-term uncertainty around simulating development out to 2050.

Figure 12: Summary of scenario design for CCDR Iraq EPM modelling



Note: Percentages show CO₂ reduction relative to the Current Policies Scenario.

Note these reductions in annual emissions are scaled linearly through the period and become effective in 2025. The model was designed to not abate in 2021–25, as the primary near-term focus is to first meet the gap between supply and demand, building committed combined cycle gas turbine conversions and plants, and reducing the reliance on liquid fuels.

4.2.2. Cross-Scenario Analysis: Role of Clean Technologies and Phasing Out Liquid Fuels

Closing the supply-demand gap would require 15.6 GW of legacy conversions²⁸ in all scenarios by 2025 (except for the Carbon Reduction Scenario [CR60], at 12.7 GW). This indicates that legacy conversions are of crucial importance for meeting unmet energy demand (~63 terawatt-hours in 2021) in the near term. They also provide the lowest-cost option for dispatching the availability of

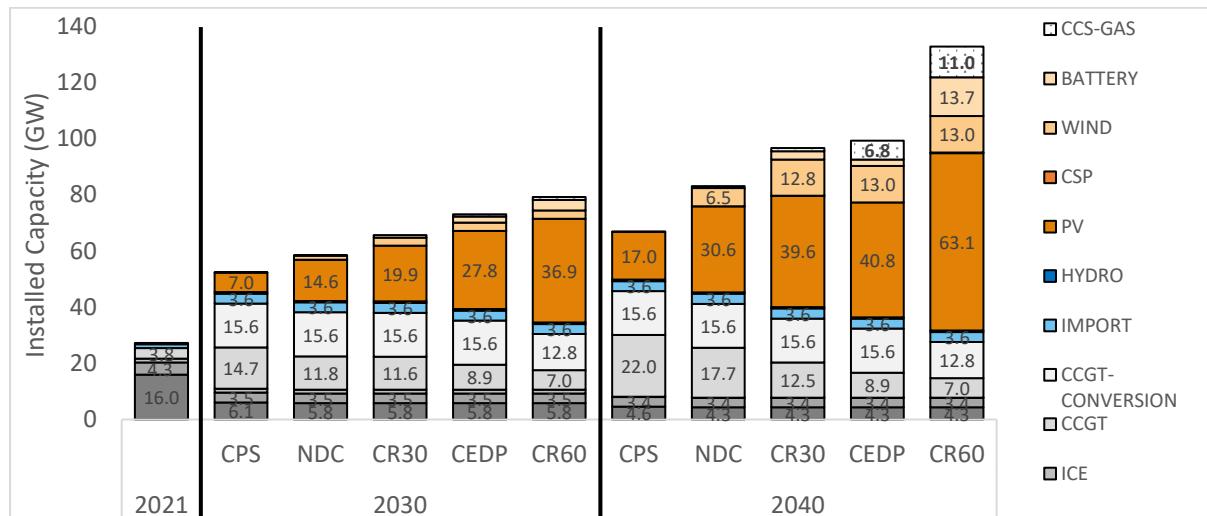
²⁷ Levelized cost of energy (LCOE) as reported by the EPM model, expressed total annual system costs/total production of generation (this includes storage discharge).

²⁸ Legacy conversions refers to the reproposing or redeployment of existing power generation assets to accelerate decarbonization.

expanded gas supply, replacing inefficient heavy fuel oil (HFO)-/diesel-based power generation, and reducing the reliance on output from liquid fuels. Figure 13 shows a cross-comparison snapshot (in 2021, 2030, and 2040) of the total installed capacity mix of each scenario. Capacity supply for new combined cycle gas turbine plants becomes incrementally lower, building just 7 GW by 2040 in CR60, down from 22.7 GW in the Current Policies Scenario (CPS). Detailed comparisons across all scenarios is provided in Annex A.

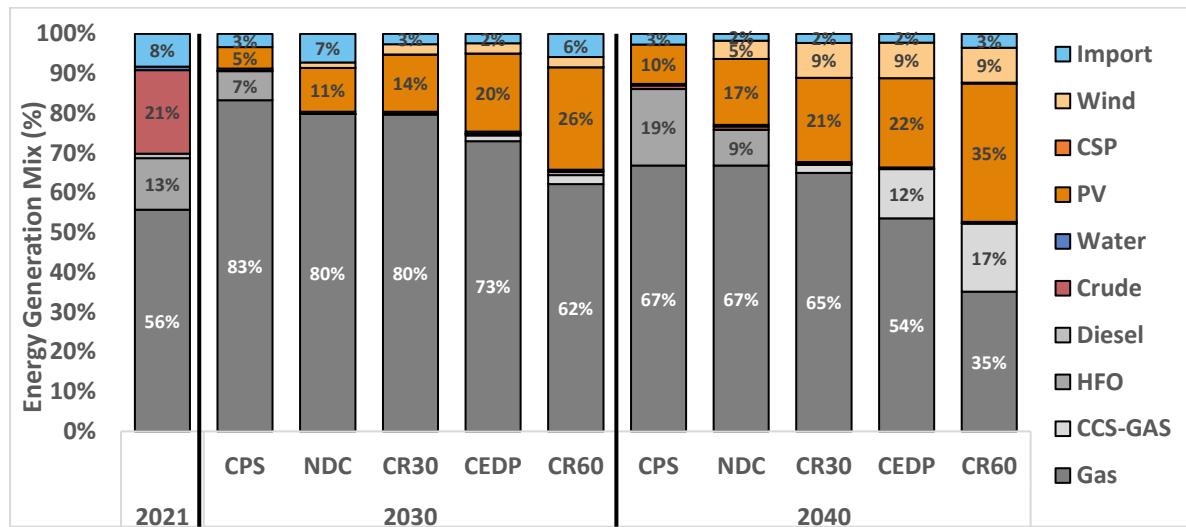
A progressive increase of renewable energy expansions is crucial for decarbonization. Results indicate that by 2040, 37 GW of RE are built in NDC, 52.5 GW in CR30, 54 GW in the Cost Effective Decarbonization Pathway (CEDP), and 76 GW in CR60, up from just 17 GW in the CPS. Most added renewable energy capacity is solar photovoltaic, supplemented by some wind energy, with 6.5 GW building in the NDC, and up to the current full economic potential of 13 GW developing in the CR30, CEDP, and CR60 scenarios by 2040. CR60 requires the greatest uptake of battery energy storage systems (BESSs) (13.7 GW / 87.5 gigawatt-hours by 2040), which begin to be essential for load-shifting to meet evening peaks when developing beyond 55 GW of renewable energy capacity. Carbon capture and storage (CCS) gas starts to enter as a least-cost option for abatement (competing with solar + BESS) when moving beyond 30 percent reduction targets, relative to the CPS.

Figure 13: Installed capacity by scenario, 2021, 2030, 2040 (GW)



Decarbonization displaces liquid fuels with renewable energy for abatement efforts up to a 30 percent target. Reducing emissions beyond 30 percent requires a combination of renewable energy (backed by storage) and CCS-gas. As shown in Figure 13, we first see a displacement of HFO in NDC and CR30 with solar photovoltaic and wind. Moving beyond 30 percent began to replace gas with CCS-gas and renewables (CEDP and CR60). These trends are reflected in the share of annual fuel consumption, as starting from the CR30 scenario onwards, liquid fuels no longer reemerge in 2034 and are instead displaced by lower-cost renewable energy options. Integrating a larger share of renewable energy for decarbonization has the twofold benefit of preventing a reemergence of the consumption of liquid fuels for power generation. Figure 14 shows annual fuel consumption by type across the five scenarios. We can see that liquid fuels (HFO) remain necessary for meeting peak demand throughout the period in CPS, while in the NDC, liquid fuels are displaced by 2029 but reemerge again in 2034. In CR30 onwards, liquid fuels remain displaced in the system, and further marginal abatement efforts begin to lower the consumption of gas.

Figure 14: Energy Generation Mix by Fuel, 2021 2030, 2040 (%)



Decarbonization drives down the systemwide leveled cost of energy (LCOE) until it reaches 42 percent abatement relative to the CPS. In 2040, the CR60 scenario yields the highest LCOE of US\$49.97/megawatt-hour(MWh). The CPS and CEDP are economically indifferent at US\$45.70/MWh and US\$45.69/MWh, respectively in 2040. NDC and CR30 provide the lowest LCOE, down to US\$43.58/MWh and US\$42.64/MWh (see Figure 17).²⁹ Note that unsubsidized fuel prices are considered in the model (indicating the economic value of fuels according to benchmark World Bank forecasts applied to Iraq). The projected cost of renewable energy is declining and renewable energy thus offers a lower-cost option for initial cuts in power sector emissions. However, deeper decarbonization scenarios (> 42 percent) require the development of more expensive generation from CCS-gas plants and significant BESS storage to back a high uptake of renewable energy plants. When further breaking down costs of energy, we can see a shift in the composition of 2040 annual power system costs from fuel-dominant (US\$8.7 billion, 58 percent) in CPS, to annualized capital expenditure (CAPEX) dominant (US\$9 billion, 50 percent) in CR60, where fuel costs are reduced to 4.6 billion (25 percent).³⁰

Decarbonization of Iraq's power system will be extremely capital-intensive. By 2040, the CPS scenario requires US\$33 billion in total investments, with the NDC rising to US\$43 billion, the CR30 to US\$53 billion, CEDP to US\$63 billion, and the CR60 scenario up to US\$95 billion. In CR60 we observe a significant spike in CAPEX that begins to occur over 2039–40, indicating that abating further beyond 60 percent begins to require even greater capital investments in generation and storage infrastructure.

Captured gas supply directed to the power system is fully consumed in all scenarios, with the exception of CR60, which uses, on average, 90 percent of it. These results indicate that gas will play a key role in power sector decarbonization—even with abatement targets beyond 60 percent. As such, it is unlikely that investments in capturing gas flaring and expanding the available

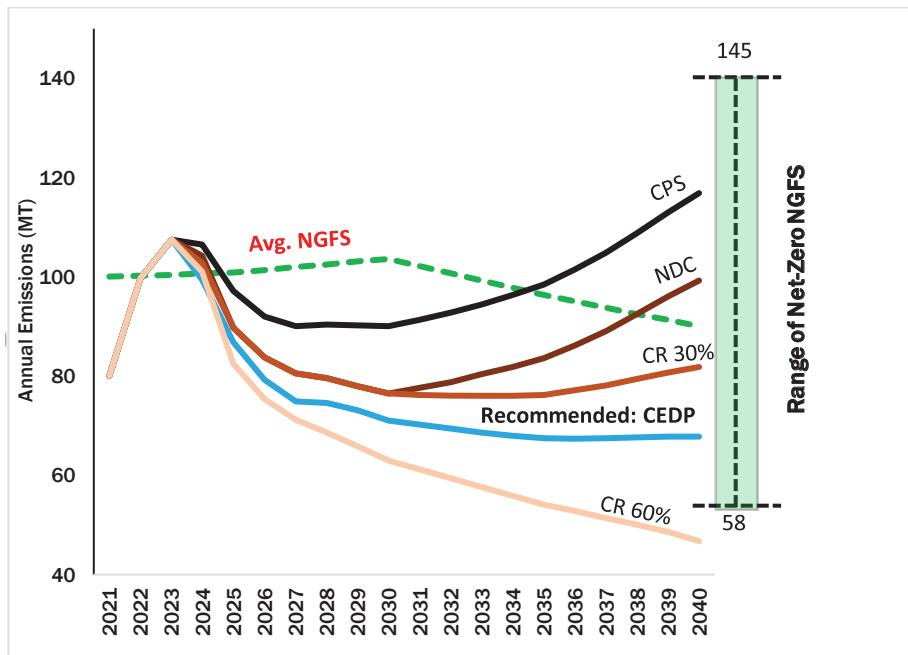
²⁹ LCOE as reported by the EPM model, expressed total annual system costs / total production of generation (this includes storage discharge).

³⁰ Chart shown without the cost of unmet demand in year 2021.

power-sector supply of gas will be at risk of becoming stranded assets in deep power-sector carbon reduction scenarios.

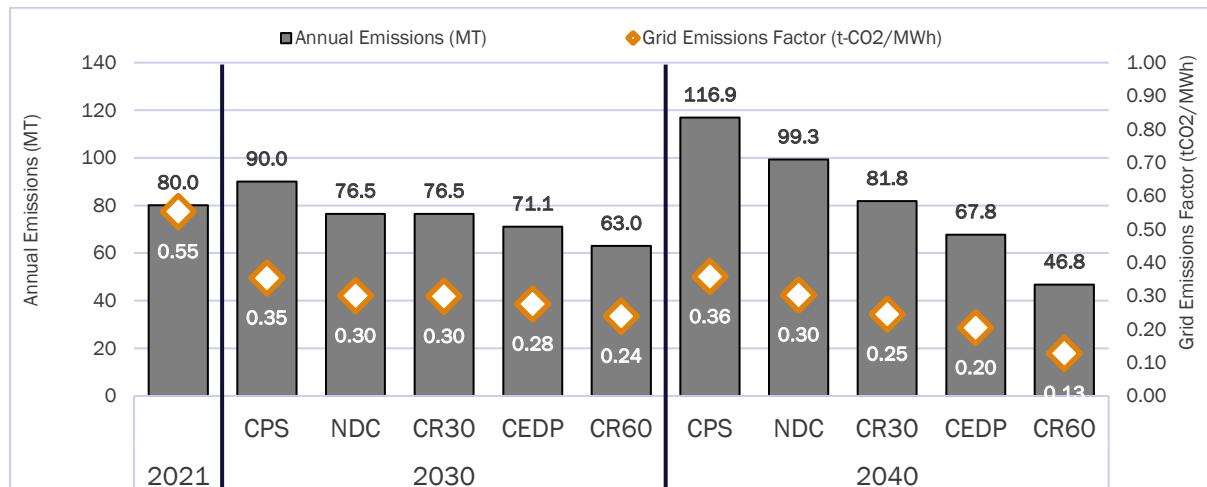
Projected emissions reductions indicate a substantial opportunity for decarbonizing Iraq's power sector over the 2021–40 period without large increases to power system costs on a levelized basis. By 2040, the CPS emits up to 117 Mt (0.36 tCO₂/MWh). The NDC scenario reduces it by 15 percent to 99 Mt (0.30 tCO₂/MWh), CR30 by 30 percent to 82 Mt (0.23 tCO₂/MWh), CEDP by 42 percent to 68 Mt (0.20 tCO₂/MWh), and CR60 by 60 percent to 47 Mt (0.13 tCO₂/MWh). However, each requires significantly greater investments in clean and renewable technologies. Figure 15 shows annual emissions by scenario in the power sector.

Figure 15: Annual power sector emissions by scenario



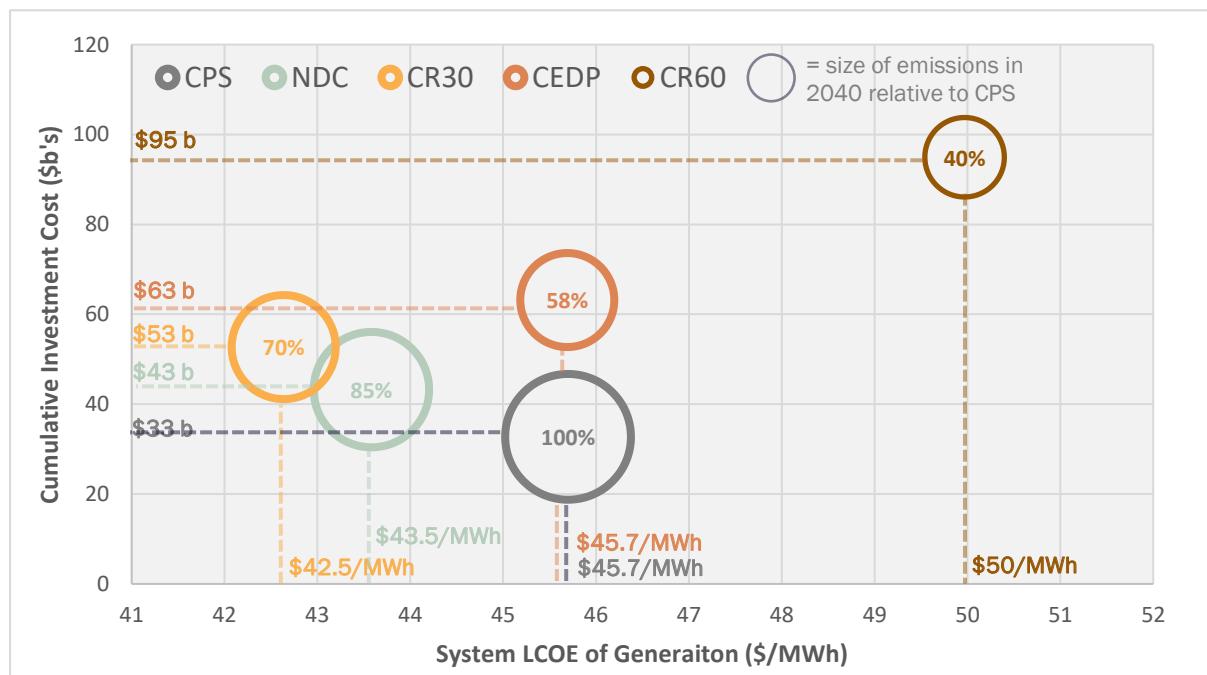
The CEDP scenario is the recommended pathway for Iraq. It is compatible with Iraq's development needs and is aligned with the transition towards a net-zero world. As shown in Figure 15, the CEDP scenario still prioritizes filling that 63 terawatt-hours gap in supply and demand in the near-term, while meeting new growth in generation. However, instead of a traditional-gas dominant fuel mix that still relies on about 20 percent of generation from liquid fuels, the CEDP scenario maintains a full displacement of HFO and Crude and results in renewables contributing to a 33 percent share of the domestic energy generation mix. After also including the introduction of CCS-Gas, traditional fossil-fuels comprise just a 55 percent share of the energy mix by 2040. The CEDP offers emissions reduction below the average Network for Greening the Financial System net-zero projections and is closer to the lower end of their emissions' range (the REMIND-MAgPIE 2.1-4.2 model).

Figure 16: Annual Emissions and Emissions Intensity, 2021, 2030, 2040 (Mt)



Having a robust electricity network infrastructure plays a key role in supporting the decarbonization of Iraq's power sector. Overhauling Iraq's power grid consists of three major components: (i) rapid expansions at the high voltage grid level, (ii) network development at the distributional level, and (iii) the implementation of smart metering programs. Additionally, decarbonizing Iraq's power sector will require flexible power trading agreements to import power during evening and overnight periods and to export during day-time hours of peak solar generation. Therefore, the degree of decarbonization efforts taken in Iraq's power sector will have implications on its potential role in regional power trade with neighboring MENA countries.

Figure 17: System LCOE of Generation (\$/MWh, X-Axis) in 2040 / Cumulative Investment Cost (US\$ billions, Y-Axis) / Emissions relative to CPS (%, size of circle)



4.3. Decarbonizing Transport

Iraq's transport sector contributes around 13 percent of total GHG emissions and is considered the biggest source of air pollution in the country. Over the last decade, Iraq's transport sector's emissions have grown by 80 percent. The number of vehicles has increased by over four times between 2007 and 2013 (Jassim, Ibraheem, and Zangana 2015)—such aggressive growth has led to carbon monoxide quantities to increase from 364 to 1571 tons/day over the same period. Similarly, nitrogen oxides quantities have increased from 28 to 127, mass particulate quantities have increased from 5 to 24 micrograms per cubic meter, and CO₂ quantities have increased from 6,068 to 27,382 tons over the same period.

The transport sector in Iraq faces major challenges. These challenges are directly linked to (i) the increase in private vehicle ownership, (ii) lack formal organized public transport system in urban areas, (iii) freight transport being heavily reliant on roadways, and (iv) the provision of transportation services being heavily reliant on SOEs. Iraq's rapid urbanization has been accompanied with rapid motorization. The total number of automobiles in Iraq has risen from 5.66 million in 2015 to 6.44 million in 2020. The number of vehicles in the capital, Bagdad, has increased over six-fold between 2007 and 2020 and account for almost 30 percent of the total vehicles in the country. This rise has largely been driven by an increase in private vehicle ownership. Public transport's presence is very weak in Iraq. The dominant form of public transport is small, privately operated minibuses that serve dedicated routes but without a specific timetable or scheduled stops.

4.3.1. Priority Pathways to Decarbonize Transport

In comparison with a business-as-usual (BAU) scenario, three focused scenarios were modeled for Iraq's transition to clean and green transportation over the 2040-time horizon. These scenarios cover three major action components: modal shifts in passenger vehicles and freight, and renewal for light goods vehicle (see Table 1). A stylized national emission modelling analysis was performed to model these scenarios.

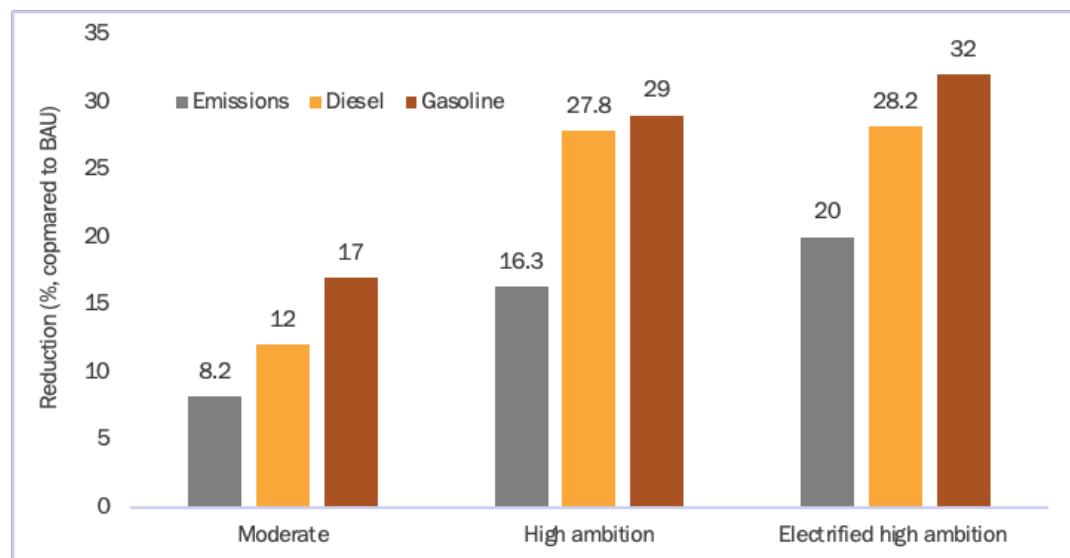
The results indicate that the moderate ambition, high ambition and the electrified high ambition scenarios would reduce Iraq's transport sector emissions by 2040 by 8, 16, and 20 percent, respectively (see Figure 18). In 2040, the Moderate Ambition scenario, transport carbon emissions will increase to 143.8 MtCO₂e, an abatement of 12.9 MtCO₂e, compared to the BAU scenario. In the High Ambition scenario, emissions will increase to 131.5 MtCO₂e, an abatement of 25.2 MtCO₂e. In the Electrified High Ambition scenario, emissions will increase to 125.4 MtCO₂e, an abatement of 25.2 MtCO₂e. In parallel to reducing emissions in the moderate and ambitious scenarios, Iraq also would reduce its reliance liquid fuels accordingly (see Figure 18).

Transport decarbonization efforts in Iraq should focus on modal shift rather than electrification. In terms of investment needs, the BAU scenario requires US\$14.75 billion; the Moderate Ambition, High Ambition, and Electrified High Ambition would require US\$ 22.2, 31.26, and 49.75 billion, respectively. The carbon emissions reductions per dollar invested from inducing modal shift toward greener modes—like public transport and railways, in the moderate and high ambition scenarios—are higher than the gains from electrifying these modes.

Table 1: Scenarios for Iraq's transition to clean and green transportation

Component	Scenarios			
	Business-as-Usual (BAU)	Moderate ambition	High ambition	Electrified high ambition
Modal Shift, Passenger Modal shift from the use of private transport modes to public transport ³¹	No action	Modal share of public transport is 25 percent by 2040	Modal share of public transport is 35 percent by 2040	Modal share of public transport is 35 percent with gradual uptake of electric vehicles and taxis and electric buses
Modal shift, freight Modal shift of freight transport from road to rail	No action	Modal share of rail freight is 10 percent by 2040	Modal share of rail freight is 30 percent by 2040	Modal share of rail freight is 30 percent with uptake in electric heavy goods trucks
Renewal for light goods vehicle	No action	Modal share of CNG light goods vehicles is 25 percent	Modal share of CNG light goods vehicles is 50 percent	Modal share of light goods vehicles is 50 percent with uptake in electric light goods vehicles

Figure 18: Reduction of carbon emissions, diesel, and gasoline fuel in Iraq's transport sector under the studied scenarios



31 Assumption: All cars/taxis are assumed to be petrol/gasoline.

5

Macro-Fiscal Implications of Low-Carbon Transition

5. Macro-Fiscal Implications of Low-Carbon Transition

Iraq did not manage to fully exploit its oil dividend to foster sustainable long-term growth, and the low economic diversification is one of the structural constraints weighing on Iraq's future growth potential. Indeed, GDP growth was primarily driven by capital (mainly in oil sector) and to a lower extent labor, rather than productivity gains. Public spending has been extremely biased towards non-discretionary spending leaving limited fiscal space for public investment in non-oil sectors. Rigid public expenditure increased in tandem with the rising oil production capacity of the country. This was evident by a growing public wage bill and transfers (including subsidies), which together went from constituting just over 50 percent of total spending in 2010 (25 percent of GDP) to a sizeable 64 percent a decade later (21 percent of GDP).

Within this context, Iraq is contemplating its own energy transition. The proposed energy transition in Chapter 3 will come at a cost as it requires significant investments. This cost is amplified by global climatic conditions; by uncertainty over global commodities markets, making oil prices and production more volatile; and by a water shock that seems inevitable for Iraq and will result in a deeper scarcity and the need for more adaptation measures. Will this cost be prohibitive to undertake such a transition? What are its macroeconomic returns? Can the Iraqi government bear the related fiscal and external impact? How do reforms linked to macroeconomic stability and diversification facilitate the adoption of this transition? These are the questions that the report will attempt to explore in its scenario simulations below.

5.1. The Macroeconomic Implications of the Transition Pathways

Five scenarios are modelled to capture the macro-fiscal characteristics of the transition pathways for Iraq's electricity sector. Those scenarios are aligned with those presented in the power sector decarbonization analysis in Chapter 4; and they have two underlying assumptions: (i) a water shock represented by a 20 percent reduction in water availability, which will impact the agriculture and food sectors as well as the overall productivity of the economy³²; and (ii) an oil price assumption based on market trends and World Bank commodities projections. The scenarios are differentiated in terms of emissions reduction, usage of various fuel mix, investment needs for electricity generation (CAPEX), and related operational costs (operating expenditure, OPEX). Those parameters are extracted from the EPM model described in Chapter 4. Table 2 summarizes those scenarios. The simulations are conducted with the help of a macrostructural country model developed by the World Bank (MFMMod).³³ Detailed comparisons across all macroeconomic scenarios is provided in Annex B.

Investments in the decarbonization electricity transition pathways and the consequent emission reduction are expected to boost GDP growth. In addition to the direct impact on GDP from raising investment levels, meeting all the growing electricity demand in Iraq will have a positive effect on firms' productivity and cost of operations in all sectors. It will also benefit households and consequently boost private consumption. The larger the investment and the deeper the decarbonization pathway, the more significant is the positive impact on growth. As such, simulations show that the CEDP and CR60

³² See chapter 4 for a detailed discussion on water scarcity impact on the Iraqi economy.

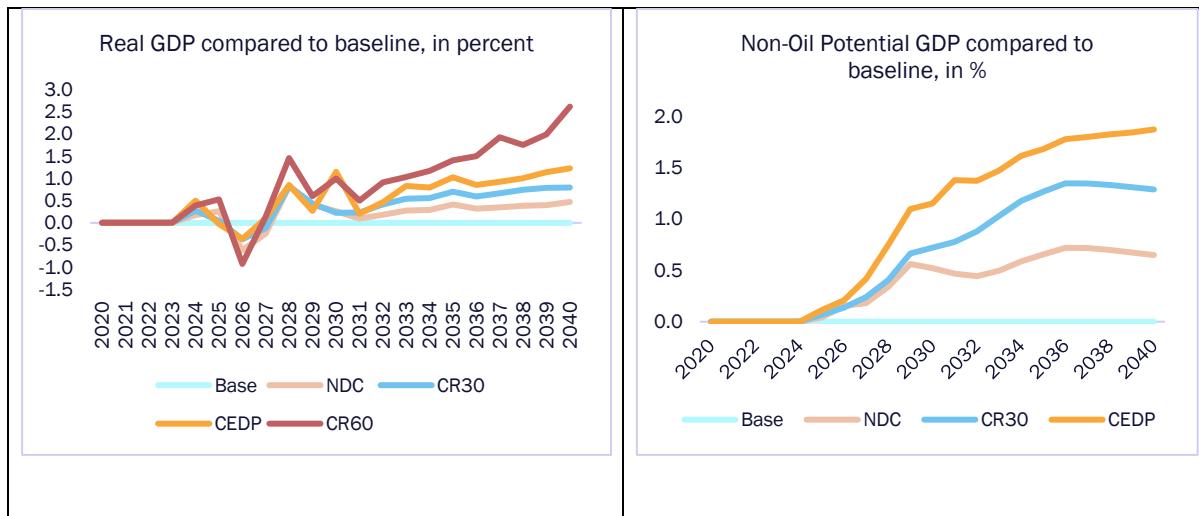
³³ The MFMmod is a customizable classic Keynesian (IS-LM) model with supply side, and well-defined cross-country trade, remittances and commodity interlinkages. The model is used for forecasting/projecting in-country simulations, and for global modeling.

scenarios will boost GDP by 0.1 and 0.15 percent, respectively, by year 5 of the transition, compared to the Base scenario. And growth gains are realized at an accelerating pace over time (Figure 19a). More importantly, the transition is also expected to raise non-oil GDP growth (Figure 19b). This opens the door for Iraq to improve its economic return on capital, labor and productivity, allowing economic activity to grow at a faster pace in the future.

Table 2: Summary description of modelled scenarios

Scenario	Electricity Transition	Exogenous Assumptions	Brief Description
Base	Gol current policies based on committed plans to 2027, available fuel supply, minor role for renewables. Very high annual emissions.	20% water reduction + oil price assumptions from WB commodities projections (average US\$68/barrel over 2019-2040)	<ul style="list-style-type: none"> - Cumulative investments: US\$32.7 Billion - Annual system costs excluding annualized CAPEX: US\$11.9 billion - Cumulative Emissions: 1,962 MT - Annual Emissions: 116.88 MT
NDC	No regret scenario. Gol meets the Nationally Determined Contributions targets (15% emissions reduction by 2030 maintained out to 2040).	20% water reduction + oil price assumptions from WB commodities projections (average \$68/barrel over 2022-2040)	<ul style="list-style-type: none"> - Cumulative investments: US\$43.2 Billion - Annual system costs excluding annualized CAPEX: US\$10.3 billion - Cumulative Emissions: 1,745 MT - Annual Emissions: 99.35 MT
CR30	Moderate decarbonization pathway. Abatement efforts extend out the NDC target trajectory to 2040. 30% emission reduction by 2040. Most lower cost opportunities for power-sector abatement have been taken.	20% water reduction + oil price assumptions from WB commodities projections (average \$68/barrel over 2019-2040)	<ul style="list-style-type: none"> - Cumulative investments: US\$52.7 Billion - Annual system costs excluding annualized CAPEX: US\$9.3 billion - Cumulative Emissions: 1,656 MT - Annual Emissions: 81.81 MT
CEDP	Cost-Effective decarbonization pathway. Iraq achieves the highest level of abatement without increasing the levelized system cost of energy (LCOE). 42% emissions reduction by 2040. Marginal abatement costs for further reductions become expensive.	20% water reduction + oil price assumptions from WB commodities projections (average \$68/barrel over 2019-2040)	<ul style="list-style-type: none"> - Cumulative investments: US\$63.2 Billion - Annual system costs excluding annualized CAPEX: US\$9.3 billion - Cumulative Emissions: 1,528 MT - Annual Emissions: 67.79 MT
CR60	Deep decarbonization pathway. Over a majority of Annual Power System Emissions are abated by 2040. 60% annual emission reduction by 2040. Marginal abatement costs for further power sector reductions become very high.	20% water reduction + oil price assumptions from WB commodities projections (average \$68/barrel over 2019-2040)	<ul style="list-style-type: none"> - Cumulative investments: US\$94.9 Billion - Annual system costs excluding annualized CAPEX: US\$9.5 billion - Cumulative Emissions: 1,352 MT - Annual Emissions: 46.75 MT

Figure 19: (a) Decarbonization pathways are supportive of growth, and (b) raise the non-oil GDP potential of the country



Low absorption capacity for investment and crowding out private investments are among the main trade-offs to be considered when the transition moves forward. The country currently suffers from public investment bottlenecks, weak business environment, and competitiveness constraints that have often delayed many infrastructure projects most notably in the energy sectors. Moreover, the size of these required CAPEX has the potential to crowd out private investments. This is the case if the Government of Iraq (GoI) decides to rely more heavily on budgetary financing from domestic sources to finance the transition; or if it is forced to reprioritize budget away from pro-growth or pro-poor programs to manage the growing fiscal deficit. The transition will also add pressure on external financing as notable capital imports will be required to meet those energy investments. This adds pressure on the central bank's foreign currency reserves and on the exchange rate. Given those pressures on imports, simulations indicate that the transition could widen the current account balance by 0.8 percentage points of GDP (ppt) if the GoI prioritizes the CEDP over existing plans (Base scenario). This divergence could reach 1.1 ppt if deep decarbonization (CR60) option is considered.

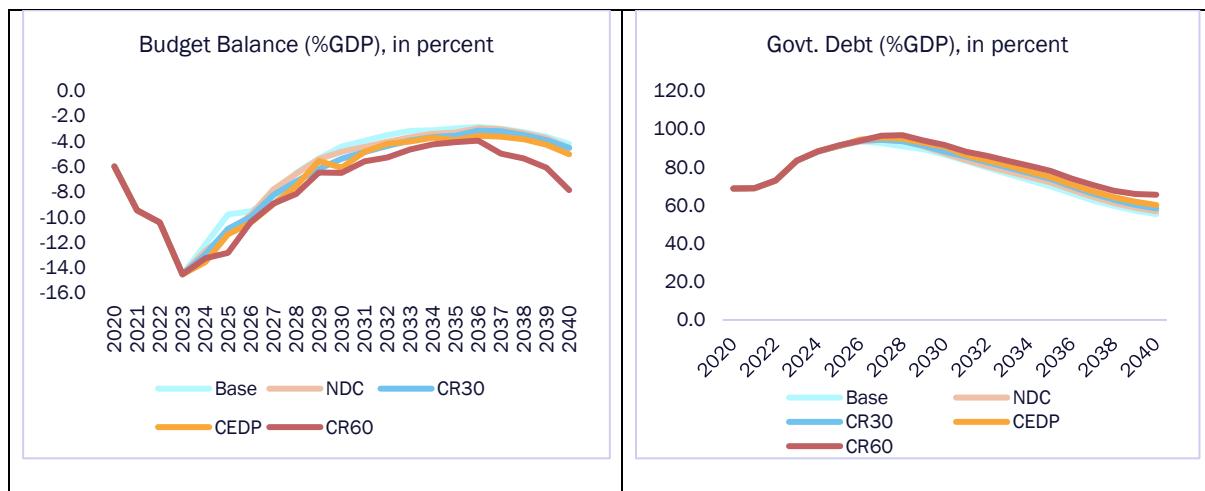
The fiscal cost is expected to be elevated given the investment intensity of the transition and high subsidy in the absence of sectoral reforms that ensure cost recovery in the electricity sector. Simulations show that the transition, in all its pathways, is expected to be investment-intensive with the cumulative CAPEX required by 2040 ranging between US\$32.7 billion in current policies scenario (GoI current plans- Base) to US\$94.9 billion for the CR60 (deep decarbonization) pathway. A notable share of the investment is frontloaded. In the CEDP 28 percent of total CAPEX is required by 2025. This is US\$17.8 billion, equivalent to a yearly average of 2.3 percent of GDP. In the absence of cost recovery reforms, this raises the fiscal costs of the transition and brings the average total budgetary expenditures between 2022 and 2040 to 46.2 percent of GDP for Base and 46.7 percent of GDP for CEDP.³⁴ See Table 2 for detailed cross-scenario comparison.

The fiscal deficit and public debt will reach critical levels under all transition pathways, including the one aligned with current GoI plans. Simulations reveal that undertaking one of the electricity transition pathways under current conditions would raise the fiscal deficit to an average of between 10.9 to 12 percent of GDP in the first 5 years, and between 3.8 to 5.7 percent of GDP by 2040 (Figure 20a),

³⁴ OPEX yearly average by 2025 is 8.9 percent of GDP.

bringing public debt to critical levels (between 90.8 and 96.7 percent of GDP in year 5 and between 55.4 and 65.5 percent of GDP by 2040) (Figure 20b). It should be noted that debt levels are decreasing despite the consistently negative budget balance due to faster GDP growth as the electricity demand gap is closed, which will improve the debt ratio over time. In the absence of reforms, especially those linked to cost recovery in the electricity sector, the transition pathways' fiscal implications are steep and could have detrimental implications for the economy. Those fiscal implications are also implied for the current government plans to meet the electricity demand gap (Base scenario).

Figure 20: (a) transition will come at a fiscal cost that (b) that will have an impact of public debt levels



As a result, Iraq's low carbon power sector transition will have to be accompanied by reforms for it to succeed. Four areas of structural reforms can be identified in the short to medium term:

- Electricity sector reforms focusing on reducing technical and nontechnical losses, and improving cost-recovery through tackling tariffs, billing, and collection issues.
- Revising electricity subsidies to target only the most vulnerable groups of the population.
- Fiscal consolidation focusing on boosting domestic revenue mobilization and tackling non-discretionary spending, most notably the public wage bill.
- Public-private partnerships to attract private financing and alleviate part of the CAPEX financing burden from the budget.

Growth and economic diversification related reforms, like those considered in the Gol White Paper and the Iraq CEM 2020 (World Bank 2020a), are also important to consider for the feasibility of the transition. Moreover, the transition will be sensitive to evolving conditions in global oil markets.

5.2. Sensitivity of the Transition to Various Climate Worlds

The macroeconomic outcomes of the energy transition for Iraq will heavily depend on the global efforts towards reduction in carbon emissions. Due to the global nature of the climate change challenge and the interconnectedness of trade, Iraq's economic prospects will not only be determined by its own policies but also by the efforts and carbon reduction policies (or lack thereof) pursued by other countries. Given the overdependence of the country on oil, such policies would influence global oil markets (through demand and prices) and in turn could impact Iraq's growth (in oil and non-oil sectors), fiscal and external balances, and financial sector operations. These oil market dynamics could also have significant implications on Iraq's welfare, social, and political prospects as previous cycles have shown.

The macroeconomic modeling exercise is extended to assess the impact of three main scenarios of global energy dynamics on Iraq's macroeconomy. Iraq is a “climate-taker” given the small relative size of its economy,³⁵ and emissions are counted towards the country’s domestic consumption (not exports of energy) in the framework. The interplay between local and global transition is reflected in four additional scenarios (Table 3). Scenarios “Base+Net Zero”, “Base+IEA NDC” and “Base+Stated Policies” are broadly in line with the Intergovernmental Panel on Climate Change trajectories of greenhouse gases—Representative Concentration Pathway (RCP) 1.9, RCP 4.5, and RCP 8.5, which highlight IEA’s global assumptions related to international oil markets (prices and demand). As such, these scenarios can be thought of as a sensitivity analysis to oil price variations for measuring the outcome of the Iraqi transition. An additional scenario (CEDP+IEA Net Zero) is defined to assess a more ambitious yet feasible quasi-cooperative scenario towards Net-Zero targets at both global and country levels. Under the “CEDP+IEA Net Zero” scenario Iraq is assumed to follow the cost-effective decarbonization transition pathway (similar to the CEDP scenario above) in conjunction with the global Net-Zero scenario. A summary of these scenarios is outlined in Table 3.

Table 3: Iraq climate pathways under different global scenarios*

Scenario	Description	Global energy scenario	Crude oil price (2022-2040 average)	Iraq crude oil production volume ³
Base + Net Zero	<i>Iraq BAU in a “good climate world”:</i> Base Scenario in a Net-Zero policy world leading to less than 2 degrees warming (RCP 1.9)	IEA’s “Net-Zero”	US\$35/bbl	3.2 mbpd, 2022-2040 average (3.7 by 2025, 3.3 in 2030 and 2.5 mbpd by 2040)
Base + IEA NDC	<i>Iraq BAU in an “intermediate climate world”:</i> Base Scenario in a climate world where other countries meet NDCs, leading to 2 degrees global warming (RCP 4.5)	IEA’s “NDCs”	US\$61/bbl	4.5 mbpd, 2022-2040 average (4.4 by 2025, 4.6 in 2030 and 4.7 mbpd by 2040)
Base + Stated Policies	<i>Iraq BAU in a “bad climate world”:</i> Base Scenario in a climate world where other countries follow stated policies, leading to 4 degrees global warming (RCP 8.5)	IEA’s “Stated-Policies”	US\$71/bbl	4.9 mbpd, 2022-2040, average (4.5 by 2025, 4.9 in 2030 and 5.3 mbpd by 2040)
CEDP + IEA Net Zero	<i>Iraq decarbonizing path in a “good climate world”:</i> CEDP Scenario in a Net-Zero policy world leading to less than 2 degrees warming (RCP 1.9)	IEA’s “Net Zero”	US\$35/bbl	3.2 mbpd, 2022-2040 average (3.7 by 2025, 3.3 in 2030 and 2.5 mbpd by 2040)
Notes:				
*) These scenarios are consistent with the assumptions considered under the EPM model (Chapter 3) and the water shock of 20 percent reduction in water supply (see Chapter 4). Moreover, each scenario’s investment, electricity costs, and emissions remain the same as the underlying Iraq pathway (Table 2).				
*) Climate scenarios only consider the change in energy demand under the relevant global emission trajectory.				
3- Iraq’s crude oil production volumes are assumed to grow in line with projected OPEC production under each climate world.				

³⁵ Iraq accounts for 0.2 percent of world GDP and 0.6 percent of global CO₂ emissions in 2020.

Simulations reveal the stark macroeconomic implications for Iraq in a decarbonizing world. Under the “Base+Net Zero”, “Base+IEA NDC” and “Base+Stated Policies” scenarios, average annual GDP growth in 2023–40 is estimated to be 1.2, 0.5, and 0.2 pp lower than the baseline (Base scenario), respectively. This effect cumulatively, would lead GDP to be 20.6 percent smaller by 2040 under “Base+Net Zero” (Figure 21a). In the fastest global transition path, a significant share of Iraqi oil infrastructure could become obsolete as stranded assets. Beyond this effective decline in the capital stock, the direct impact of the oil sector contraction will be limited due to its low labor intensity. However, the indirect impact of the global energy transition will be more significantly felt through the non-oil economy where most Iraqis are employed. The non-oil economy is primarily impacted through a decrease in consumption demand as higher savings are incentivized by a higher effective interest rate to meet the required investment needs (Figure 21b). This higher investment will be met with higher imports of machinery and equipment, which in turn increase pressures on the external balance at the same time as oil revenues plummet (Figure 22a).

A global decarbonization path would significantly add to Iraq’s fiscal pressures and lead to ballooning public debt. The overall fiscal deficit-to-GDP ratio is expected to reach a staggering 65, 21, and 6 percent of GDP by 2040 under IEA’s Net-Zero, Stated Policy, and NDC scenarios, respectively (Figure 22b). The decline in government revenues through oil revenues in “Base+Net Zero” is the sharpest across the global climate scenarios. This outcome is reinforced with higher expenditures associated with the climate transition paths which results in the fastest transition scenarios to show the largest upward shift in the fiscal deficit. The debt-to-GDP ratio will also grow rapidly to well beyond sustainable levels (more than 300 percent of GDP in “Base+Net zero”) due to the growing fiscal deficit and a denominator effect of nominal GDP contraction. Those scenarios remain illustrative though to showcase the sensitivity of the transition to oil outcomes. It does not incorporate external adjustments (at the level of OPEC and other oil producers who might change production profiles to keep oil prices higher) nor domestic adjustments (at a certain level of deficit and debt, markets will force convergence and hence other spending items will automatically adjust to new fiscal realities).

The associated growth and fiscal impacts could be marginally mitigated if Iraq embarks on the most efficient path of emission reduction. Comparing the results for the “Base+Net Zero” and the “CEDP+IEA Net Zero” in the above figures reveals that, an active response to the climate reality and optimization of a least-cost energy transition can partially mitigate the negative impact of global transition away from carbon. As discussed in Chapter 3, this transition is necessary for Iraq to close the supply-demand gap in electricity. Thus, the macrosimulations show that the CEDP option for the electricity generation can also be a preferred path for Iraq’s macroeconomy under two climate world scenarios. In a net-zero emissions world, the magnitude of the collapse in oil receipts will make it unlikely that Iraq can invest in any of the transition pathways.

Figure 21: (a) The economic returns of the transition in Iraq are highly sensitive to developments in global oil markets, and (b) the affordability of the investments to be made

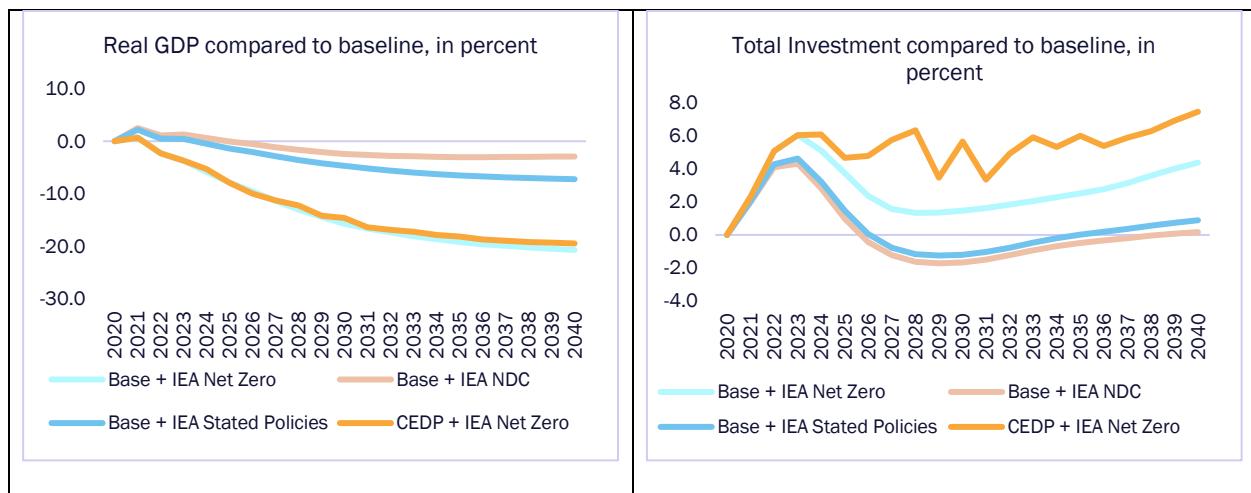
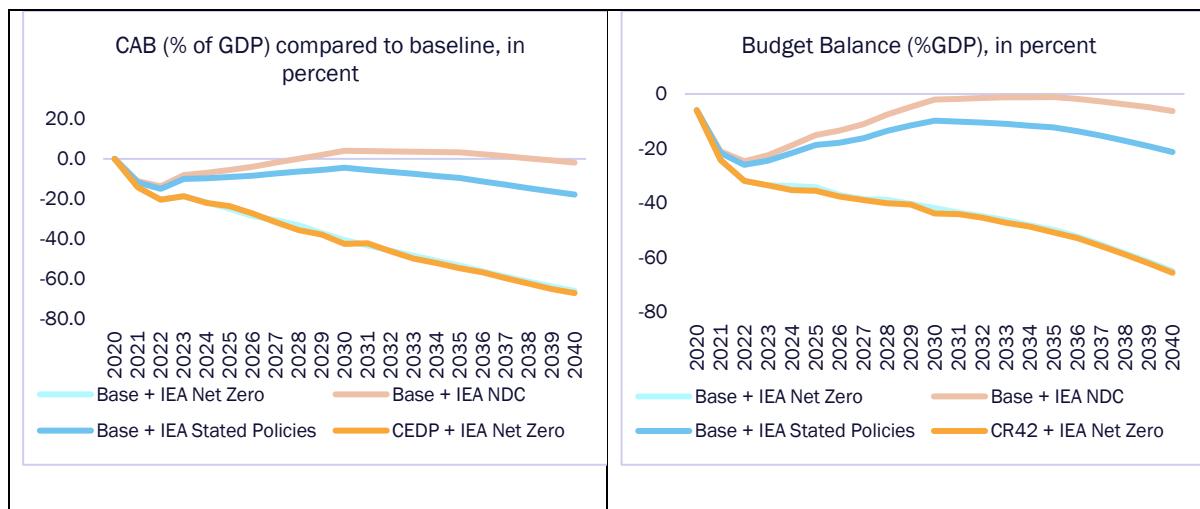


Figure 22: (a) External pressures mount with declining oil prices, and (b) so does the fiscal balance



5.3. Reforms as a Necessary Condition to Ensure a Successful Transition

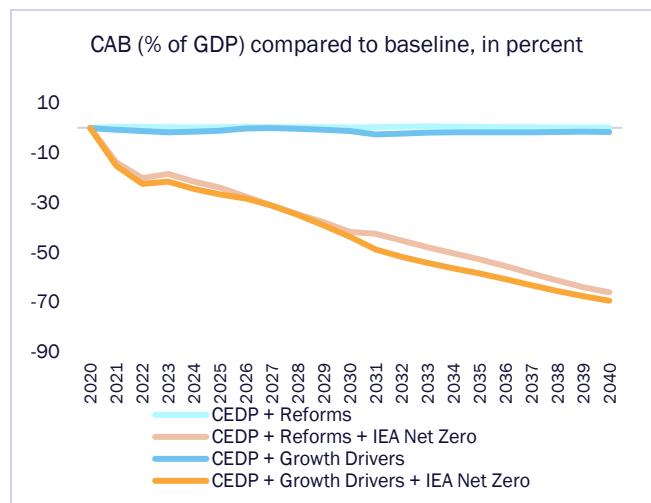
Reforms are a necessary condition for Iraq to afford the energy transition and benefit from its economic returns. These reforms are short- to medium-term in nature and focus on improving cost recovery in the electricity sector, fiscal consolidation, and securing private investment. All these proposed reforms are not new but have been in the making for years and clearly articulated in the GoI white paper. To quantify the case, the model simulates a comprehensive fiscal reforms scenario (RS1). This scenario assumes (i) a rise in OPEX recovery from 10 to 50 percent through improved collection, reduction in nontechnical losses, and tariffs hikes; (ii) fiscal consolidation through wage bill controls as well as boosting domestic revenue mobilization by 2 percent of GDP over two years through customs and income tax reforms; and (iii) ensuring 20 percent in private financing for the required CAPEX, tapping into growing global interest in renewables' investment as well as implementing the regulations linked to the unified gas framework to attract foreign direct investment.

Fiscal reforms allow the decarbonization pathway to raise the country's growth potential further, contain external pressures and generate fiscal savings. The proposed bundle of fiscal reforms can make the

cost-effective decarbonization transition pathway (CEDP scenario) highly feasible. Reforms gradually reduce the fiscal deficit by 4.5 ppt in the first 5 years compared to a CEDP transition with no reforms and turns it into a surplus thereafter; reducing as such the debt-GDP ratio (Figure 23). In addition to bridging the country's electricity demand gap, private investments would have a high multiplier effect. Therefore, energy transition coupled with reforms are projected to boost GDP by 0.3 percent in the first 5 years (and thereafter), as well as raise non-oil GDP potential by 0.35 ppt. Finally, reforms absorb external pressures coming from rising capital imports given additional inflows and reduction in public consumption. This raises the average current account deficit by only a mere 0.03 percent of GDP compared to the Base scenario.

Reforms would bring fiscal and growth gains, but these would not be enough to fully cushion the detrimental effects of the collapse in oil receipts under a net-zero climate world. If countries move globally on reducing GHG emissions and manage to achieve net-zero targets, the success of the Iraq energy decarbonization pathway would be questionable. Scenario “CEDP+Reforms+IEA Net Zero” scenario shows widening fiscal and current account deficits by a staggering 53 and 71 ppt by 2040, respectively, compared to the Base scenario and a 20 percent reduction in GDP growth (Figure 23). This would also send public debt to GDP ratios well beyond sustainable levels (more than 300 percent of GDP).

Figure 23: Reforms are needed to absorb the fiscal cost of the transition, but might not be enough in a net zero climate world



As such, Iraq should seize the current moment of high oil prices to change its development model and move fast on its growth diversification agenda and energy transition. Frontloading reforms and investment will maximize the benefits for Iraq as the world moves gradually towards net-zero climate world. Delays in doing so will make it harder to afford and implement the transition. The cyclicity of the oil price merits a rethinking of the fiscal policy management framework in Iraq. This includes discussing the role of fiscal rules and sovereign wealth fund especially in this global transition toward less reliance on carbon intensive sources of energy and growth.

Growth and diversification focused reforms will boost the economic returns from the transition. The GoI has laid down a series of reforms that would help Iraq move along the economic diversification agenda. Implementing diversification related reforms would raise the GDP per capita for Iraq by 58 percent (Iraq CEM 2020). It does so as reforms would lead to raising non-oil related capital accumulation, boosting human capital formation, and address labor force participation bottlenecks, especially amidst women,

to levels at par with UMICs' average.³⁶ The model simulates the macroeconomic effects of the transition under such growth and diversification focused reform agenda ("CEDP+Growth drivers" scenario) and finds significant economic gains. Indeed, simulations show a rise of 6.5 and 9.9 percent for GDP and non-oil GDP potential respectively for the "CEDP+Growth drivers" scenario compared to the Base scenario by 2040³⁷. Such economic gains will make the energy transition more feasible.

The proposed reforms can help absorb costly adaptation measures in the face of a water scarcity shock as part of the transition. An adaptation package, on top of the energy transition, is proposed encompassing US\$70 billion of investment and operational spending till 2040 related to critical hard infrastructure such as rehabilitation of dams, barrages, regulators, drains and canals, and reclamation and modernization of irrigation; as well as non-structural or soft investments/programs in water and agriculture such as farmer-led organizations capacity building, cost recovery policy reform, and water conservation programs. The package is mostly frontloaded given the nature of the problem, and these adaptation measures are estimated to reduce water scarcity by half (down to 10 percent). Macro simulations reveal that introducing this package would add a significant 0.12 percent to GDP in the first 5 years on top of the gains from the CEDP transition pathway and the accompanying fiscal reforms (0.87 percent by 2040). However, the fiscal costs would see the budget deficit averaging 11 percent of GDP in the first 5 years (with public debt reaching 94 percent of GDP) before declining to an average of 4.3 percent thereafter (with public debt dropping to 58 percent of GDP by 2040). Deeper fiscal reforms, growth enhancing structural reforms and availing private financing for investments would make the adaptation measures more affordable.

5.4. Poverty Impact

The impact of different climate change scenarios will differ across households depending on their human capital endowments and labor market responses. To capture the distributional and poverty impacts associated with different low-carbon transition pathways, climate and reform scenarios, a macro-micro model was developed building on household survey data from the 2012 Iraq Household Income and Expenditure Survey, the latest available household survey which provides nationally representative data on consumption, demographic characteristics, labor incomes, and sectors of employment.

In line with the expected positive impact on GDP growth and private consumption simulated in section 5.1, investments under the decarbonization electricity pathways are expected to have a positive, albeit marginal, impact on poverty reduction. According to baseline simulations, poverty in Iraq—as measured at the US\$3.2 international poverty line—is expected to remain quite stable over the period 2025–40. In the absence of structural reforms sustaining more inclusive growth dynamics such as policies aimed at improving human capital, reducing regional inequalities and boosting job creation in the private sector, the limited growth envisaged under the baseline scenario will not translate into any meaningful progress in terms of poverty reduction. This picture will change only marginally once considering the higher growth expected with increased investments required to meet electricity demand needs and decarbonization scenarios (see Figure 24). The decline in poverty is expected to increase the higher the investment and the deeper the decarbonization pathway, with gains growing over time.³⁸ By 2040, under the recommended CEDP decarbonization scenario, the share of Iraqis living below the US\$3.2

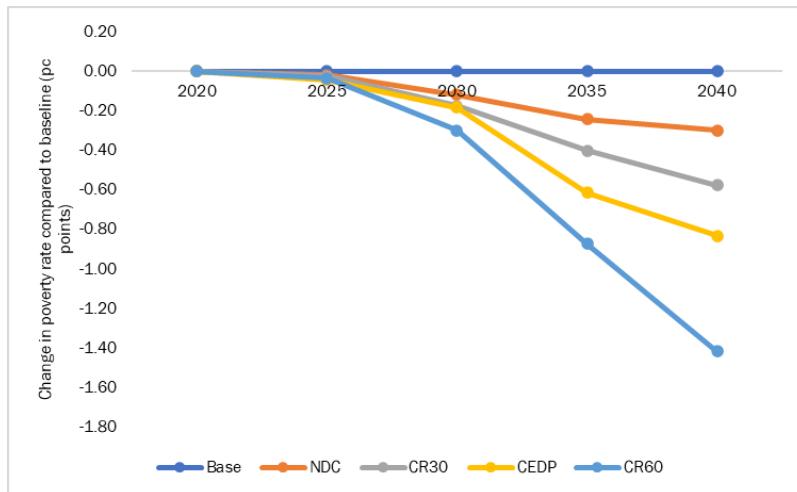
³⁶ See Iraq CEM 2020 for a detailed description on reforms, impact, and methodology (World Bank 2020a).

³⁷ The effect is 2.3 and 8 percent respectively by the end of year 5 of the transition.

³⁸ Findings are driven by higher real wages and household consumption compared to the baseline scenario. Under scenarios S2–S6 there is no sizeable reallocation of employment across sectors.

international poverty line is expected to decline by 0.83 percentage points compared to the baseline. Inequality is expected to increase marginally over time, with no sizeable difference across scenarios.

Figure 24: Poverty impact under different decarbonization electricity pathways



Global energy and climate dynamics can further constrain Iraq's capacity to tackle poverty in the years to come. A deteriorating climate environment will have a strong negative impact on productivity and labor incomes, particularly for the poorest and most vulnerable segments of the population.³⁹ Moreover, the trickle-down impact of lower international oil prices on public finances, coupled with higher investment needs for energy transition are likely to squeeze social spending or, at the very least, prevent GoI from tackling head-on the root causes of poverty through investments to boost human capital and equalize access to services and opportunities for the population.

Substantial progress in poverty reduction can only be achieved if energy transition is accompanied by structural reforms aimed at boosting growth while protecting the poor. Higher growth associated with structural reforms focused on achieving both economic diversification and energy transition will result in strong gains in terms of poverty reduction. Under the growth scenario, Iraq's poverty rate measured at the US\$3.2 international poverty line is expected to decline by as much as 8 percentage points compared to baseline. These findings, however, only take into consideration the poverty reduction impact deriving from higher growth rates for real wages and real household consumption as well as from higher employment levels. Several of the proposed reforms – notably removal of energy subsidies and fiscal consolidation – are likely to have distributional implications that would require mitigation in order to protect the poorest segments of the population and ensure that growth is inclusive.

³⁹ Poorer households rely relatively more on labor incomes for their livelihoods compared to non-poor households, especially from work in construction and agriculture (discussed further in Section 6.2 below).



6

Ensuring an Inclusive and Just Transition

6. Ensuring an Inclusive and Just Transition

The different climate change scenarios and transition pathways analyzed above present both challenges and opportunities for Iraq's workers. Because these challenges and opportunities vary by sector, type of employment and worker profile, policies for mitigating the downside impacts and ensuring an inclusive and just transition for workers will need to factor in these considerations.

6.1. Understanding Current Jobs Challenges

A low carbon transition in oil-dependent Iraq brings risks that may trigger deep economic and societal transformations. The oil sector in Iraq plays a disproportionate role in labor market outcomes and job creation, mostly through indirect channels related to public sector employment. The oil-funded public sector provides almost 40 percent of all jobs in Iraq. A large portion of the oil sector's revenue has been used to expand the public sector. Between 2003 and 2015, the public administration added approximately 2.1 million jobs (excluding SOEs).⁴⁰ The public wage bill is the largest and fastest growing expense in the government budget (World Bank 2017).

Iraq's oil sector employs less than 1 percent of the workforce and is spatially concentrated, suggesting that workers in most regions of Iraq have limited access to well-paid employment outside of government jobs. Basrah employs the highest proportion of oil workers (63 percent) followed by Baghdad (12 percent) and Kirkuk (10 percent). Basrah also has the third highest proportion of public sector workers. Despite benefiting from oil and a large public sector presence, Basrah faces persistent economic development challenges. The governorate is still recovering from years of war and turmoil, and is plagued by relatively high unemployment. Other governorates also rely heavily on public sector jobs – even rural governorates. A significant public sector presence, where compensation is markedly higher than in the private sector, effectively pulls up wages in the private sector and crowds out private job creation. Regional labor markets across Iraq are therefore significantly distorted by oil-related activities and the prominent public sector.

The high levels of labor market segmentation mean that workers in low paid jobs or earning meager livelihoods struggle to access good quality jobs. This includes workers in rural regions, where a smaller range of jobs is available and pay less. This includes women, who account for only 14 percent of total employment. Women in Iraq face few attractive work opportunities outside the public sector, which offers women the best job prospects, working conditions and wages, especially in public administration and the education and health sectors. Youth in particular struggle to access formal work, despite rising educational attainment among younger age cohorts.⁴¹ The relatively poor work prospects lead some youth to queue for public sector vacancies (in light of the public sector wage premium of 37 percent); the vast majority of female youth, however, exit the labor force altogether. Private sector employment is dominated by jobs in the low productivity wholesale and retail trade sector (23 percent) and construction sector (20 percent), and most lack access to social protection.

Agriculture is an important source of employment and livelihoods in Iraq, especially for the 29 percent of the population residing in rural areas, even though agriculture incomes are low. Agriculture is also the main source of livelihoods for rural women. Agricultural production tends to be more labor-intensive than other sectors, and accounts for 30 percent of female employment nationally, and 40 percent of

⁴⁰ Employment in SOEs was nearly 500,000 in 2016.

⁴¹ One quarter of youth ages 15–24 work in construction, followed by 16 percent in wholesale and retail, 14 percent in manufacturing and 14 percent in agriculture.

rural female employment. In contrast, only 8 percent of men work in agriculture jobs (and only 5 percent of rural males). Most agricultural workers are unpaid (88 percent of females and 85 percent of males), which reflects the importance of subsistence agriculture, especially for low-income households. Moreover, the food system accounts for a solid share of rural employment, providing manufacturing jobs accessible to the relatively low-skilled workforce. About 16 percent of workers in the manufacturing sector engage in activities related to food processing (including manufacturing of food products, beverages and tobacco products).

6.2. Climate Change Impact on Jobs

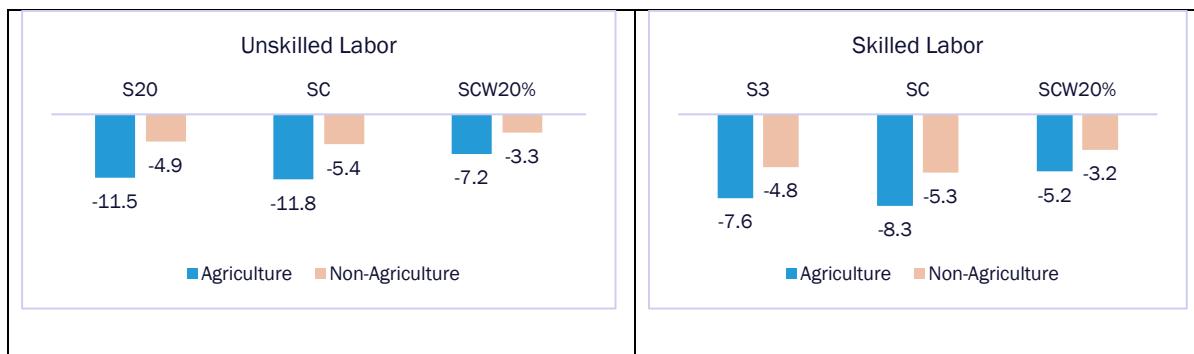
Iraq's challenging labor market context is not sustainable – not in fiscal terms, not in environmental terms, not in demographic terms – and is at risk of severe disruption from climate change. To consider the potential impact of climate change on jobs and on workers, two main transmission channels are considered: (i) water scarcity and drier weather patterns due to increasing temperatures; and (ii) reduction in oil production and scaled back public sector employment. Whereas much of Iraq's population will feel the effects of water scarcity and higher temperatures in one way or another, agriculture sector workers, construction workers, and those employed in agriculture value chains will bear the brunt. Despite the low quality of agriculture and construction jobs, agricultural production is essential to supporting household food consumption needs and livelihoods among the poor and among less educated rural women, and construction work is a mainstay for less educated males.

Within agriculture, the projected negative impact of water scarcity on jobs is larger than the impact on production, especially for unskilled jobs. The CGE model in the *Water in the Balance* report estimates that under a 20 percent reduction in water availability and temperature impacts on crop yields (scenario SC), the demand for unskilled labor in the agriculture sector will be 11.5 percent lower in the medium term than in the base year, and the demand for unskilled labor in other sectors will also fall, by an estimated 4.9 percent. In fact, any major permanent reduction in agricultural activities diminishes the demand for both unskilled and skilled labor (Figure 25). After construction, agriculture is the main sector of employment of the poor ([Figure 26](#)).

The impact on jobs outside of agriculture are the cumulative result from multiple channels. Lower agricultural output will affect downstream industries such as food processing and services like food retailers, restaurants and hotels, and associated construction and transport. Because water is a direct input to production in many industries and service sectors, reduced access to water will negatively affect sector output, which in turn can increase poverty rates, unless climate smart transformation of the agri-food sector takes place. Another channel through which water scarcity can affect workers is via migration due to unsustainable living conditions when water quality falls below critical thresholds. Water-stressed communities in the south of Iraq will increasingly migrate north or to large cities in search of sustainable livelihoods.

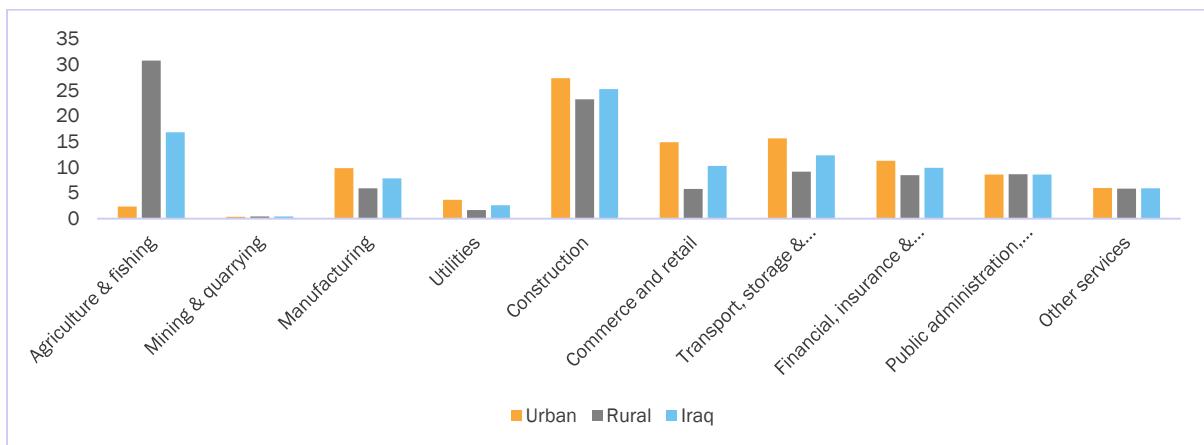
Worker productivity faces direct risks from climate change through exposure to higher temperatures. For workers whose occupations require them to work outside, increased frequency of extreme heat and longer heat waves undermine worker performance and productivity. This was confirmed through discussions with oil workers from Basra, particularly the heightened health risks for maintenance oil workers due to their consistent exposure to temperatures exceeding 50 degrees Celsius. Agriculture and construction sector workers are expected to be the most affected by hotter working conditions: 35 percent of Iraq's agricultural workers and a similar share of construction workers are exposed to extreme heat conditions, while around 45 percent of agriculture and construction workers face at least moderate heat exposure (see Figure 27). Given that jobs in these sectors are rarely formal or salaried and compensation is mostly tied to output, reduced labor productivity translates into lost earnings.

Figure 25: Percent change in demand for skilled and unskilled labor in agricultural and non-agricultural activities.



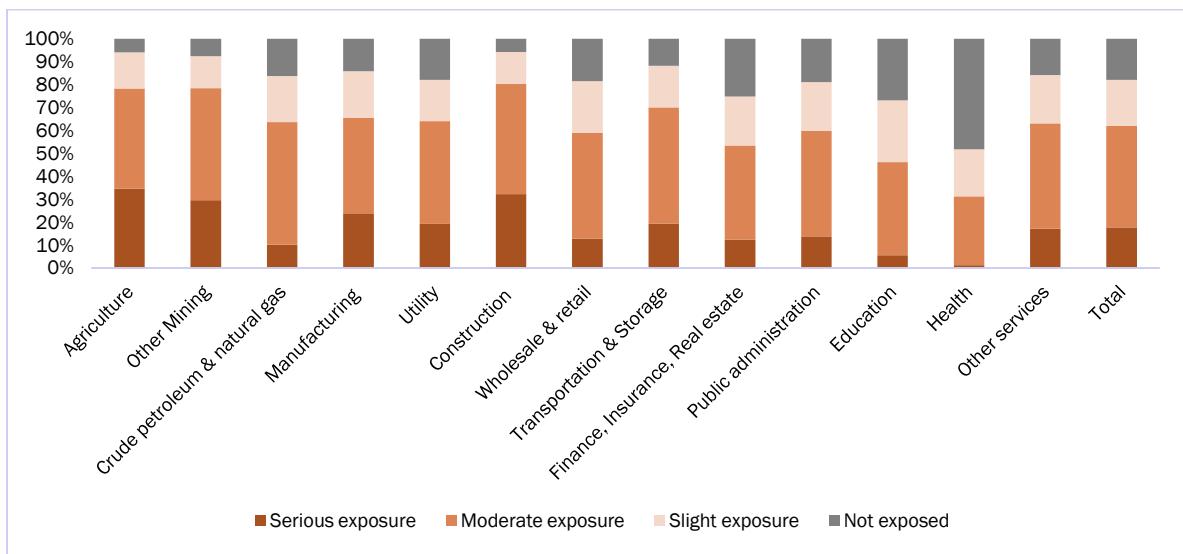
Source: (World Bank 2020b)

Figure 26: Distribution of poor by their sector of employment (in percent).



Source: 2012 Iraq household socio-economic survey

Figure 27: Degree of workers exposure to heat by sector



Source: authors' estimates using 2012 IHSES data

As the world transitions away from fossil-fuels and demand for Iraq's oil exports eventually weakens, the resulting strain on government revenues will create pressures to reduce public employment. A more streamlined public administration – at a size more in line with international norms – will need to become

more efficient in order to deliver essential services with fewer resources. Public sector retrenchment brings significant challenges in any country context; in Iraq, these may be particularly severe, given the state's central role in the economy. Public sector layoffs would not only cut off a key source of household incomes; it could also remove families' access to social protection systems.

6.3. Using Climate Action and Green Transition to Generate More and Better Jobs

Transitioning to a more sustainable economy is a must; the challenge lies in mitigating the negative jobs impacts and at the same time facilitating private sector activity that can meet the changing needs and preferences of consumers and provide new and/or better livelihoods for Iraq's workers. The transition needs to be supported by policies and reforms that facilitate adjustment in the workforce, invest in human capital, improve labor mobility and foster private sector creation of more and better jobs, and accompanied by social dialogue and mitigation measures to ensure sustainable livelihoods across the country.

There are several channels through which investment in climate actions can generate jobs. The high levels of investment modeled in the various decarbonization pathways will stimulate new labor demand in renewable energy generation. PV installation and maintenance jobs are especially labor intensive, mostly concentrated in low-skilled construction occupations that require modest upskilling, but also requiring skilled technicians, technical/engineering designers, and management skills. Other renewable energy technologies will also require a cadre of skilled labor. Policies to incentivize energy efficiency investments are also very labor intensive, both at the lower skill level as well as in mid- to high-level positions related to energy audits, environmental monitoring services, and green building code enforcement, for example. In the case of agriculture, incentives to help farmers shift to climate-smart crops, drought tolerant varieties, and more sustainable production methods can be supported through training to encourage uptake. Although most agriculture jobs are relatively low-skilled, climate-smart applications will require new skills, not only related directly to production but along the value chain including packaging, transport, sales and marketing.

The job-creating investments described above should be complemented by policies that mitigate job losses or threatened livelihoods. For example, social protection measures such as unemployment benefits and social assistance will smooth household consumption while displaced workers search for new jobs. Payments for environmental services – similar to conditional cash transfers – could be an effective way to protect vulnerable ecosystems and sustain households that subsist on marginal lands. Green public works programs can provide temporary incomes to help households weather labor income shocks. Active labor market programs such as job search assistance and training can help connect job seekers with employers. Better preparing future labor market entrants through modernized curricula that are more STEM-oriented, climate-aware and conducive to innovation will produce a workforce that is more capable of responding to the challenges of green transition. Any future streamlining of public sector employment should ensure delivery of basic services, with a focus on education and health services that are key to maintaining and enhancing labor productivity through human capital accumulation. The demand for teachers and health professionals will in fact increase at least with natural population growth⁴² but likely faster, given rising educational attainment and worsening climate- and non climate-related health challenges. Protecting budgets for education and health providers would in practice shield female public sectors workers from layoff, resulting in a more gender-inclusive public work force.

⁴² According to Iraq's Ministry of Planning, the country's population increased by 2.5 percent between 2020 and 2021, which is significantly higher than the global average.

6.4. Transparency and Public Engagement on Climate Change

Increasing transparency and public engagement on climate change is a core aspect of just transition, both to generate buy-in and foster behavioral adjustments for climate change mitigation and adaptation efforts, and to galvanize citizen-led climate change efforts to complement GoI climate change plans and commitments.

However, access to adequate information on climate change appears to be limited and inconsistent. Findings of the March 2022 social media survey on climate change indicate that 55 percent of respondents were unaware of any source of information addressing climate change. Disparities in access to information appear to be particularly marked between male and female respondents; while 54 percent of male respondents report being familiar with at least one source of information on climate change issues in Iraq, this is the case for only 35 percent of female respondents. The percentage is even lower (closer to 21 percent) for female homemakers. Information on climate change from scientists appeared to be by far the most trusted source of information (85 percent of respondents), followed by family and friends (67 percent of respondents). Only 35 percent of respondents underscored their trust in climate change information shared by the central government, and 33 percent for information disseminated at the governorate level.

There appears to be substantial public appetite for action on climate change, given awareness and strategic opportunities to be able to do so. This was reflected during successive discussions with the multi-stakeholder advisory group set up to provide technical inputs on this report⁴³. It was also manifested during the roundtable discussion convened with youth activists and students in Baghdad in May 2022, particularly through the showcasing of successful social enterprises on clean energy access and utilization of organic waste for livelihood generation. Similar findings emerged from the social media survey; 49 percent of respondents indicated that they would be willing to make substantive changes to how they live and work to address the effects of climate change, including prioritizing seasonal fruits and vegetables, making more efficient use of resources, sorting waste, and utilizing renewable energy. Of these respondents, 60 percent were under the age of 35. The survey also found that better access to climate change information would help respondents contribute more to climate change action, as well as knowing that their efforts contributed to climate change actions.

⁴³ The Iraq CCDR multistakeholder advisory group is comprised of representatives from GoI, the private sector, civil society and academia.

A photograph of a solar farm under a clear blue sky. The solar panels are arranged in several rows, tilted at an angle. In the background, there's a dry, hilly landscape. A vertical color bar is positioned on the left side of the image.

7

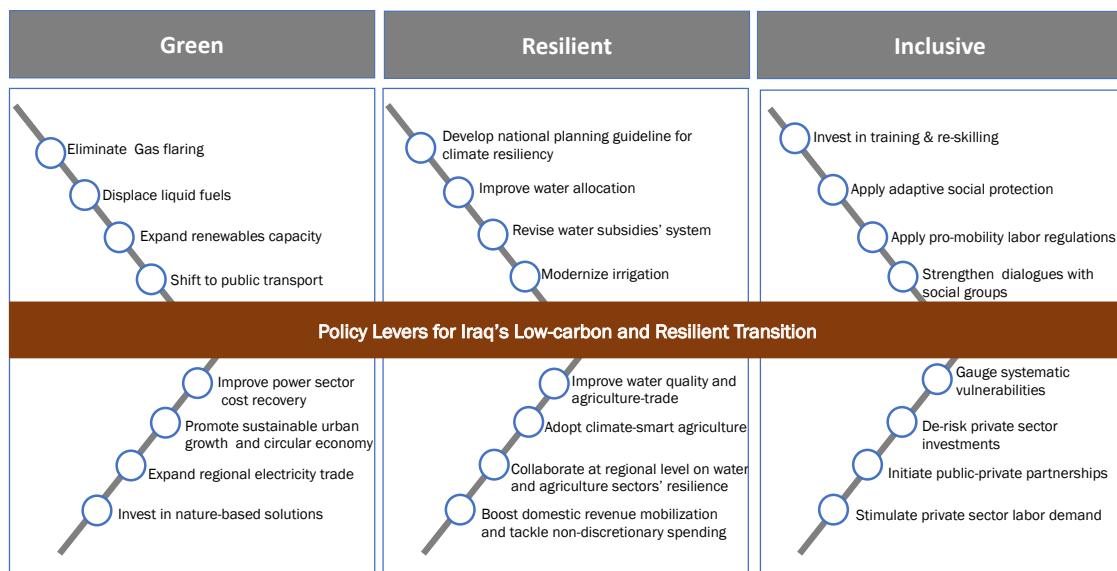
Policy Levers and Investment Needs

7. Policy Levers and Investment Needs

7.1. Policies for Resilient and Low-Carbon Development

The proposed Iraq CCDR policy interventions have been selected to respond to the specific development gaps identified in the analysis, with a focus on short-term needs. These policy levers span the World Bank's green, resilient, and inclusive development framework (see Figure 28). More details about specific actions under each policy lever are included in Annex C.

Figure 28: Policy levers to promote Iraq's green, resilient, and inclusive development



and a modal shift to public transport, as well as cost recovery and subsidy reforms, are crucial steps for decarbonizing Iraq's economy.

The **Resilient** policy levers include actions to:

- Improve efficiency and productivity with demand management policies including water allocation and valuation
- Modernize irrigation and drainage systems and better manage salinity
- Update the operation of dams
- Implement climate-smart agriculture, including by promoting drought and heat-resistant varieties, and improving soil management
- Repurpose public support and policies (including subsidies) toward sustainable outcomes in the water and agricultural sectors
- De-risk investments in the agri-food sector

As for **inclusion** policy levers, the challenge lies in mitigating the negative jobs impacts and at the same time facilitating private sector activity that can meet the changing needs and preferences of consumers and provide new or improved livelihoods for Iraq's workers. The transition needs to be supported by

policies and reforms that facilitate adjustment in the workforce, invest in human capital, improve labor mobility and foster private sector job creation, and accompanied by social dialogue and mitigation measures to ensure sustainable livelihoods across the country.

Tackling the people-climate-development nexus in Iraq is an opportunity to rebalance the country's growth model by putting higher emphasis on people and rebuilding depleted human capital. People are central to the climate change agenda in Iraq. As discussed throughout this report, human capital considerations are critical on both the adaptation and mitigation levels. Beyond social protection, targeting economic diversification by promoting non-oil growth requires expanding into new knowledge and technology spheres and a workforce that can drive the transition. Investing in human and institutional capital is a key ingredient of a successful green transition, especially in oil dependent countries like Iraq. Table 4 lists the main policy levers recommended for Iraq to strengthen its human capital and utilize it for climate action.

Table 4: Policy levers to strengthen Iraq's human capital to respond to climate change risks and opportunities

Pillars	Policy Levers Recommendations and Actions
Education and Re-skilling	<p>Increase of investment in developing human resources at all levels with knowledge and skills relevant to green economy to support the government agenda in combating climate change. It can start with the following action areas:</p> <ul style="list-style-type: none"> • Review and develop curricula at all levels of education to ensure the coverage and raise the awareness of climate change among the Iraqi youth; • Identify quantitative and qualitative gaps in terms of labor market and skills between demand and supply in green economy priority sectors; • Develop and deliver innovative training programs to upgrade skills of workers and scale up the operations in two urgent areas – solar PV and wind plants – for immediate benefits
Health	<p>Establishment of greener health system strengthening strategy/road map for climate change-induced natural disasters and communicable disease outbreaks.</p> <p>Proposed actions include:</p> <ul style="list-style-type: none"> • Invest in green infrastructure – design and construction of health facilities by incorporating climate-resilient design features; • Use renewable energy and energy efficiency interventions – e.g., solar direct-drive vaccine cold chain fridges; • Scale up medical waste reduction and management, including recycling of single use devices.
Social Protection	<p>Incorporate Adaptive Social Protection in the national social protection systems</p> <p>Proposed actions include:</p> <ul style="list-style-type: none"> • Development of social registry and enhance it with tools that makes it responsive to climate-related shocks, among other measures; • Facilitate transitions to green jobs; • Use public works to promote watershed management or reforestation.

7.2. Complementary Recommendations in Support of Climate Action

- **Utilize the CCDR recommended policies and investments to optimize oil revenues.** The Extractive Industries Transparency Initiative (EITI), which Iraq is already implementing, has tools that could start advancing this goal, including its current recommended environmental data reporting and contract disclosure requirements, as well as its national multi-stakeholder processes. Analysis of data reported through the EITI can help identify climate change sector-related economic risks, including lower-than-anticipated revenues and stranded assets, and “green” investment opportunities. The disclosure and analysis of the carbon intensity of exports and the impact of sector emissions on domestic climate commitments can enable a debate

between government and citizens on how the economy may be impacted in the coming decades.

- **Develop and implement a “Green Finance Framework”:** Develop and implement a “Green Finance Framework” to assist the Iraqi Financial Sector in its contributions to meet Iraq’s NDC goals. This framework can outline specific financial policies, regulations, tools and instruments that provide transitional support for new green technologies. Policies should also be established to enable investment and strengthen market incentives for low carbon infrastructure. This can include creating fiscal incentives (e.g., tax breaks) for diversification into climate resilient sectors and adoption mitigation technologies, addressing tariffs and nontariff barriers on agricultural inputs and facilitate access to new technologies for farmers through expedited procedures for releasing seeds and easier movement of agricultural specialists, and support investments in climate smart agriculture.
- **Mainstreaming climate change knowledge and adopting strategic and gradual approaches to improve public participation and accountability on climate change commitments will entail:** (i) launching an inclusive and results-oriented public outreach and engagement program on climate change in Iraq, tailored to different social groups and their respective climate specific concerns, and (ii) piloting and scaling up localized participatory approaches to climate change adaptation, which could support partnerships between local governments and their citizens to assess climate risks and identify socially inclusive solutions tailored to local needs. Investments in this regard could focus on activities that support livelihood diversification, or community-level preparedness for multiple risks, such as water conservation and more efficient use of water, support for natural resource management, rehabilitation of degraded lands, or strengthening of early warning systems.

7.3. Prioritization Matrix

Iraq is a country with tight fiscal space, limited capacities, and numerous development gaps; therefore, it is critical to prioritize and sequence recommended measures and interventions—reflecting their urgency, synergies, and trade-offs—in responding to development and climate needs. The recommended measures of this CCDR, based on the policy levers outlined in Section 7.1, are shown in Figure 29.

The recommended CCDR policy levers are designed to address immediate development gaps and ensure an inclusive transition to a low-carbon economy. To this end, it is important for the government to: (i) navigate tradeoffs in the low-carbon transition to maximize immediate benefits and reduce costs, (ii) participate in the transition as a convenor of social dialogue, (iii) address the security-climate nexus and distributional risks and impacts, and (iv) enhance trust in institutions by allowing the active participation of citizens (especially women, youth, and vulnerable groups) and the private sector.

The “no regret” measures, which are recommended for the initial five years, offer Iraq the potential to respond to its pressing development needs (thus closing development gaps) as well as achieve high transition benefits (promote efficiency and social welfare, create jobs, achieve fiscal savings, etc.). These measures refer to actions that will generate benefits no matter what happens in regard to uncertainty around global oil prices, future climate change impacts, future costs of low-carbon technologies, etc. Trade-offs are measured in terms of economic feasibility that is based on the estimated cost of the intervention. The “no regret” measures place emphasis on reversing wasteful water practices through improving water allocation, efficiency, and productivity. It should be noted that the elimination of gas flaring is low cost (in some cases negative net cost) option to abate GHG emissions. While the cumulative cost may be high into the medium to long term, as with any decarbonization option, the implementation of measures would be gradual and incremental. As such,

addressing high concentration flares, and CH₄ venting and leaks is generally comparatively easy and cost efficient.

Figure 29: Prioritization and sequencing of recommended policies and interventions

		HIGH IMPACT INVESTMENTS	NO REGRET MEASURES FOR IMMEDIATE BENEFITS
Development Urgency	High	Urgent interventions with moderate to high tradeoffs <ul style="list-style-type: none"> • Close the electricity supply-demand gap and adopt the CEDP pathway for the power and transport sectors • Modernize irrigation, manage salinity, and rehabilitate and update operations of dams 	Urgent interventions with low tradeoffs <ul style="list-style-type: none"> • Establish a sovereign wealth fund • Ensure power sector cost recovery and targeted subsidies • Eliminate gas flaring and utilize it in power generation • Improve efficiency jointly with water demand policies, including water valuation, and repurpose agriculture support policies • Strengthen private sector participation in the economy • Develop a national planning guideline for climate resiliency • Adopt national CC governance framework
	Low	MEASURES TOWARDS NET ZERO <ul style="list-style-type: none"> • Invest in CCUS and LCH • Diversification of energy exports • Expand E-mobility • Decarbonize industry, agriculture and waste sectors • Leverage regional trade and connectivity 	MEDIUM-TERM MEASURES <ul style="list-style-type: none"> • Improve water allocation and reuse of wastewater • Adopt and scale-up climate smart agriculture • Initiate methane abatement in the oil & gas sectors • Apply short and long-term labor transition policies • Curricular reforms to shift towards STEM-Climate knowledge space • Launch CC outreach and public participation program and scale up local participatory approaches
	High	Low	Trade-offs (Economic Costs)

Short- to medium-term measures, which are recommended between 5 to 10 years, are critical for Iraq to build its economic and social resilience as climate change takes a steeper turn. This would be achieved through mitigating climate-change-related shocks spatially (focusing on cities), sectorally (focusing on water and agriculture), and socially (through the application of well-designed social protection programs). These measures are also important for Iraq to build a solid base for charting its own path to a green, resilient, and inclusive transition. The long-term measures start to take effect beyond 2030, and target deeper reforms, leading to deeper decarbonization and whole-of-economy interventions. These measures are aspirational, yet they are within reach and in sync with similar policies that are applied by Iraq's regional and income peers.

7.4. Investment Needs and Financing

By 2040, Iraq requires \$US 233 billion to respond to its most pressing development gaps while embarking on a green and inclusive growth pathway (see Table 5). Financing Iraq's green transition will require the mobilization of both public and private capital and strategic deployment of public finance instruments to attract private finance. As a first step towards mobilizing climate finance, the GoI needs to create the enabling environment in which finance can be shifted from carbon intensive to green activities over time. This would involve strengthening institutional and technical capacities to address barriers to catalyzing climate investment in Iraq, including initiatives on identifying risks and opportunities for the financial sector, analyzing gaps in institutional capacity and governance, developing a green or climate finance strategy, creating a green or transition taxonomy, extensive

training and capacity building of financial market participants including banks and financial institutions, issuance of guidelines and regulations related to the identification and monitoring of climate related risk, promoting innovative financial instruments and providing incentives to diversify the energy mix (by supporting renewable sources such as solar), transition to a lower carbon path (by financing gas flaring reduction projects) and climate-resilient infrastructure.

Table 5: Summary of Iraq's investment needs to close the development gap

Component	Investment Needs by 2040 (US\$ billion)
Rehabilitation of hydraulic infrastructure and irrigation, and reclamation of irrigation	42 (CAPEX Only)
Water and agriculture non-structural investments	6
Eliminate gas flaring and utilize it in power generation	29
Adopt the CEDP pathway for the power sector	63
Overhaul the power grid	52
Adopt the High Ambition transport decarbonization pathway	31
Total	233

Strengthening of Public Financial Management system (PFM) is equally important to underpin the low carbon transition and Iraq's resilience to climate change. Relevant PFM reforms include extending the perspective of the public finances beyond the annual budget cycle, increased transparency and public reporting adapting existing PFM practices to support climate-sensitive policies, securing political backing for the transition and ensuring that basic PFM practices are in place to make these transitions affordable (green PFM). For all the steps mentioned above the GoI needs a lot of capacity building on key core areas as debt management and reporting. Green Economy knowledge and country strategy on the latter one could be built on a parallel basis. Without a reputation of transparency and a solid track record in the Climate Change and ESG area, it would be difficult to tap ESG international investors and international capital markets. The government could make some initial moves creating investment frameworks and policy measures that would support their green strategy.

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Annex A: Tabulated Power Sector Modelling Results

Category	Parameter	Unit	Base yr-2021	Timeframe	CPS	NDC	CR30	CEDP	CR60
Demand	Electricity Demand	TWh	208	2040	326	326	326	326	326
	Unmet Demand	TWh	63	2040	0	0	0	0	0
	Peak Demand	GW	30	2040	49	49	49	49	49
Capacity	Thermal Cap	GW	25.4	2040	35.7	31.1	25.9	22.3	17.6
	CCUS-Thermal Cap	GW	0	2040	0	0	1.1	6.8	11
	RE Cap	GW	0.5	2040	17	37.1	52.4	53.8	76.4
	Storage Power Cap	GW	0	2040	0	0.7	3	2.2	13.7
	Storage Energy Cap	GWh	0	2040	0	2.8	12	8.9	87.5
	Total Cap	GW	25.9	2040	52.7	69.0	82.5	85.1	118.6
Generation	Gas Fuel Consum.	m mmbtu	722	2040	1388	1388	1375	1399	1149
	Liquid Fuel Consum.	m mmbtu	481	2040	437	218	8	0	0
	Share of Gas Gen.	%	56%	2040	67%	67%	65%	54%	35%
	Share of Liquid F Gen.	%	35%	2040	20%	10%	0	0	0
	Share of CCUS Gen	%	0	2040	0	0	2%	12%	17%
	Share of RE Gen	%	1%	2040	10%	17%	21%	22%	35%
System Costs	PV of System Costs	billions	N/A	2021-2040	251	247	245	246	254
	Annual System Cost	billions	18	2040	14.9	14.3	14.2	15.2	18.3
	Levelized Cost of Gen	\$/MWh	124	2040	45.7	43.6	42.6	45.7	49.9
Investment	Cumulative Invest	billions	N/A	2022-2040	33	43	53	63	95
	PV of Cumul. Invest	billions	N/A	2022-2040	21	26	31	37	50
	Average Annual Invest	billions	N/A	2022-2040	1.6	2.2	2.6	3.3	5.0
Emissions	Annual Emiss	MT	80	2040	117	99	82	68	47
	Cumulative Emiss.	MT	N/A	2021-2040	1961	1745	1656	1528	1352
	Grid Emiss. Factor	tCO2/MWh	0.38	2040	0.36	0.30	0.25	0.20	0.13

Annex B: Tabulated Marco-Fiscal Modelling Results

	Baseline (C9) + 20% Water Reduction (\$1)				NDC + 20% Water Reduction (\$2)				EPM Investment Only				EPM Investment + IEA Scenario				
	2020	2030	2040	Deviation from Baseline (Percent)*	2020	2030	2040	Deviation from Baseline (Percent)*	2020	2030	2040	Deviation from Baseline (Percent)*	2020	2030	2040	Deviation from Baseline (Percent)*	
Average Growth (%)																	
Real GDP	5.2	3.3	3.4	0.0	0.3	0.5	0.0	0.2	0.8	0.0	1.2	1.2	0.0	-2.4	-2.9	0.0	
Real GDP per Capita	2.1	1.0	1.5	0.0	0.3	0.5	0.0	0.2	0.8	0.0	1.2	1.2	0.0	-2.4	-2.9	0.0	
Per Capita Income and Consumption (Constant 2020 USD)*																	
Real GDP Per Capita	4304.0	4765.0	5534.0	0.0	0.3	0.5	0.0	0.2	0.8	0.0	1.2	1.2	0.0	-15.7	-20.7	0.0	
Real Household Consumption Per Capita	2481.0	3066.0	4147.0	0.0	0.2	0.6	0.0	0.3	1.2	0.0	0.4	1.6	0.0	-15.7	-20.7	0.0	
Shares in GDP (% of GDP)																	
Private Consumption	43.9	49.0	57.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	-0.4	0.2	0.0	9.8	15.8	0.0	
Government Consumption	18.2	23.4	23.4	0.0	0.2	0.0	0.0	-0.2	0.0	0.0	-0.1	-0.1	0.0	0.1	2.3	0.0	
Private Investment	1.7	8.7	9.5	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.2	0.0	1.6	2.5	0.0	
Government Investment	5.7	17.3	14.6	0.0	0.0	0.2	0.0	0.4	0.2	0.0	0.9	0.5	0.0	1.1	2.1	0.0	
Net Exports	31.9	2.6	4.0	0.0	-0.1	-0.2	0.0	-0.1	-0.4	0.0	-1.1	-0.6	0.0	-0.9	-1.6	0.0	
Sectoral shares in GDP (% of GDP)																	
Agriculture	4.9	3.7	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.7	1.0	0.0	
Industry	65.2	53.1	43.4	0.0	-0.1	-0.2	0.0	-0.1	-0.3	0.0	-0.6	-0.5	0.0	-10.4	-16.3	0.0	
Services	30.4	41.3	50.2	0.0	-0.1	-0.2	0.0	-0.1	-0.4	0.0	-0.5	-0.6	0.0	-1.3	0.0	0.0	
External balance (% of GDP)																	
Exports, Goods and Services	29.3	43.4	41.9	0.0	-0.1	-0.1	0.0	-0.5	-0.1	0.0	0.1	0.2	0.0	-18.7	-25.0	0.0	
Imports, Goods and Services	31.7	58.1	65.8	0.0	-0.1	0.2	0.0	-0.5	0.3	0.0	0.6	0.7	0.0	22.1	41.4	0.0	
Current Account Balance	-3.6	-16.5	-25.2	0.0	0.1	-0.2	0.0	0.0	-0.4	0.0	-1.3	-0.8	0.0	-10.0	-18.6	0.0	
Fiscal Aggregates (% of GDP)																	
Fiscal revenue	30.7	41.8	40.4	0.0	-0.1	-0.1	0.0	-0.4	-0.1	0.0	-0.2	-0.1	0.0	-20.2	-27.3	0.0	
Fiscal expenditure	36.7	46.2	44.6	0.0	0.4	0.2	0.0	0.5	0.3	0.0	1.8	0.7	0.0	17.3	33.4	0.0	
- (w/ interest payments)	1.0	1.3	1.9	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-0.2	0.1	0.0	0.3	0.4	0.0	
Budget deficit	-6.0	-4.4	-4.2	0.0	-0.4	-0.3	0.0	-1.0	-0.3	0.0	-1.7	-0.8	0.0	-2.1	-3.7	0.0	
Public debt	68.7	86.6	55.4	0.0	0.7	1.5	0.0	1.7	0.0	0.0	4.2	4.7	0.0	10.1	165.4	0.0	
- (w/ External Public Debt)	35.6	22.5	8.5	0.0	-0.2	-0.3	0.0	-0.6	-0.3	0.0	-0.5	-0.8	0.0	-0.9	-34.8	0.0	
Emissions per unit of output (tons CO2)																	
Emissions (Mtons CO2)	80.0	90.0	116.9	#	0.0	-15.0	-15.1	0.0	-15.0	-30.0	0.0	-21.0	-42.0	0.0	-15.0	-15.1	0.0
Emissions per unit of output (tons CO2)	0.4	0.3	0.3	#	0.0	-15.2	-15.5	0.0	-15.2	-30.6	0.0	-21.9	-42.7	0.0	-10.7	-8.5	0.0
Memorandum items																	
Population (Millions)	40.2	50.2	60.6	#													
Total Population growth rate (%)	2.3	2.1	1.8														
Working Age Population (Millions)	25.1	33.1	41.6														
Working Age Population growth rate (%)	2.8	2.6	2.2														
Labor Participation Rate (%)	42.5	40.0	38.3														
Unemployment Rate (%)	16.0	13.0	13.0														

* Deviations from baseline are expressed as percent of baseline level for Real GDP Per Capita, Emissions, and Carbon Price. For all other variables deviations from baseline are expressed as percentage points of GDP in the corresponding scenario less the % of GDP in the baseline scenario. Diamonics are not additive.

(1) Average annual growth since preceding period (2000 for the first column)

Annex C: Recommended Policy Levers Green, Resilient and Inclusive Transition

Oil and Gas Sector Policies

Table C1: Policy Levers for decarbonizing Iraq's oil and gas sector

Pillars	Policy Levers Recommendations and Actions
Decarbonization of the oil & gas value chain (addressing carbon-intensity of the energy supply)	<ul style="list-style-type: none"> • Detection, measurement and inventory of O&G value chain GHG emissions at national and asset level • Assessment of applicable technical and commercial assessment of applicable mitigation and/or abatement technologies to address them • Development of a prioritized action plan and a Marginal Abatement Cost Curve (MACC) on the basis of a set of determinant variables, e.g. absolute GHG emission volumes; relative emission intensity benchmarks; geographical, technological, economic and commercial considerations for mitigation and abatement; space for private participation and investment; etc. • Assessment of the existing policy and regulatory frameworks for sustainable GHG emission mitigation and abatement, an identification of legal and regulatory gaps, and a prioritized action plan to address them • A roadmap focusing on practical and prioritized, context-specific options for concrete action to address emissions.
Gas Sector Development Framework	<ul style="list-style-type: none"> • Separation of sector policy and regulatory functions • Introduction of transparent and independent regulatory institutional and oversight framework • Elimination of regulation-by-contract practices / development of a regulatory framework • Adoption of a transparent, competitive contract award mechanism for private investment in the gas-to-power value chain
Natural Gas Flaring	<ul style="list-style-type: none"> • Introduction of a private investment-enabling framework for domestic market development and investment in flaring reduction and gas-to-power, including commercialization rights • Adoption of a transparent, economic, internationally-benchmarked pricing mechanism for domestic natural gas
Methane Abatement	<ul style="list-style-type: none"> • Improved data quality gathering and reporting • Improved monitoring technology, with capacity building of responsible entities • Defining leak reduction goals with accountabilities • Development of statutory and regulatory requirements
CCS	<ul style="list-style-type: none"> • Technical and commercial assessments of CCS potential • Development of a national CO₂ storage atlas • Development of national CCS strategy and roadmap • Inclusion of CCS in national decarbonization strategies and Nationally Determined Contribution • Development of a legal and regulatory framework for CCS • Ensuring new gas power plants are built CCS-ready • Develop a CCS pilot project to develop institutional and technical capacity • Develop a plan for strategic CCS hubs and clusters to minimize the cost of deployment
LCH	<ul style="list-style-type: none"> • Technical and commercial assessments of LCH potential • Development of national LCH strategy and roadmap • Inclusion of LCH in national decarbonization strategies and Nationally Determined Contribution • Develop a LCH pilot project to develop institutional and technical capacity • Develop a plan for strategic LCH hubs and clusters to minimize the cost of deployment

Electricity Sector Policies

Table C2: Policy levers for decarbonizing Iraq's power sector

Pillars	Policy Levers Recommendations and Actions
Regional Electricity Trade	<ul style="list-style-type: none"> • Expanding trading agreements for exporting power during day-time hours of peak solar PV generation (with lower marginal costs) and importing power during evening and overnight hours (with higher marginal costs). • Include a range of potential ancillary and emergency stand-by services in new trade negotiations, providing Iraq's system with a higher degree of system adequacy and reliability. • Coordinate Iraq's grid planning codes with the development of neighboring systems, providing the opportunity to facilitate inter-regional trade.

Upgrading electricity transmission and distribution	<ul style="list-style-type: none"> Rapid expansions at the HV grid level in the next few years to deliver power from new and converted CCGT plants to close the supply-demand gap by 2024. Network development at the distributional level (expansion of length of MV and LV lines and substation infrastructure). Rolling out of smart meters. Co-locate suitable network infrastructure with robust Solar PV and Wind resources, establishing 'renewable energy zones' in Iraq. Fully commercialize the transmission and distribution functions of the electricity sector to attract private investment.
Electricity Sector Planning	<ul style="list-style-type: none"> Clearly defined domestic RE generation targets to 2030 and 2040), encouraging a more robust representation for the role of renewable energy in the share of energy generation (as opposed to a capacity target). Carry out a detailed resource mapping and institutionalize a list of priority zones in Iraq that should be considered for development, naming them by location and providing a series of initial resource modelling assessments for project developers and investors. This can be done as part of a 'Renewable Energy Masterplan' for Iraq, which should be coordinated with the Renewable Energy Office Feed inputs from analysis on zone and site-level RE data into coordinating long-term transmission development policy with intersections of high potential Solar PV and Wind resource clusters Implement subsidy reforms on oil and gas fuels to reduce the distortion of electricity prices and enhance price discovery.

Transport Sector Policies

Table C3: Policy levers towards low-carbon transport sector

Pillars	Policy Levers Recommendations and Actions
Planning Issues	<ul style="list-style-type: none"> Prepare updated sector and sub-sector strategies and policies including: sustainable road transport, rail transport, and urban transport policies, with a view of decarbonizing the sector. Robust infrastructure planning to prioritize climate resilient transport linkages, accessibility for people and goods, and regional connectivity Support PPP pipeline development specifically in subsectors that have limited private sector engagement in this regard (roads and railways) Support the development of an improvement to intermodal transport hubs Explore partnerships and venues to mobilize green financing for the transport sector
Legal and Institutional Issues	<ul style="list-style-type: none"> Revise transport sub-sector legislation to enable private participation and align with PPP Law Reform institutional framework of transport regulatory bodies
Role of SOEs and financial sustainability issues	<ul style="list-style-type: none"> Support the corporatization of SOEs and a KPI based monitoring approach
Infrastructure Issues (for details on high priority investment needs see table below)	<ul style="list-style-type: none"> Railways: (a) Rehabilitate existing railway tracks and enhance operations by improving equipment, locomotives, and signaling; (b) build new strategic rail links to induce modal shift from roadways to railways on high traffic corridors; (c) Develop a new vision and market-based institutional structure for Iraq Republic Railways with a view of attracting the private sector for rail operations. Roads: (a) Develop an effective highway maintenance program; (b) Perform much needed maintenance of the road network, improving it to a climate resilient standard ; (c) build new strategic road links to enable trade and regional integration Urban Transport: (a) Develop a coordinated approach for urban transport planning, financing, and management; (b) Transform a large self-regulating minibus sector into an efficient and modern well organized corporate units which can offer reliable, affordable services ; (c) Develop improved public transport operation on key strategic corridors and improve walkability; (d) identified priority (BRT/metro/ Commuter train) routes.; (e) Provide basic infrastructure (stops, terminal, depot) for Public Transport. Crosscutting: Introduce vehicle scrappage programs for buses, taxies, and trucks in order to transition them to more energy efficient and cleaner technologies. Also, explore alternative fuels to support the transport sector (e.g. LNG, low Sulphur diesel). Also, the possibility of using renewable energies (if viable).

Overcoming Water Scarcity and Enabling Smart Agriculture

Table C4: Policy levers for overcoming water scarcity and enabling smart agriculture

Pillars	Policy Lever Recommendations	Activity
Infrastructure, system optimization and sustainability	Building resilience in the water sector to reduce exposure to the climate change risks of water shortage, and water shocks	Augmenting water resources with non-conventional sources (treated wastewater reuse) with demand management policies.
		Optimizing dam operation to improve resilience to floods and droughts.
	Modernizing irrigation & drainage systems for improved service delivery and salinity control	Rehabilitating and improving the irrigation water delivery systems (off-farm networks and canals)
		Managing irrigation and drainage service delivery more efficiently at the off- and on-farm interface
		Modernizing on-farm irrigation systems (improved water productivity)
		Restoring drainage systems on reclaimed land (for groundwater and soil salinization control (drainage networks).
	Adopting and scaling up climate smart agriculture and innovation to increase water productivity and build resilience of agri-food systems	Decreasing the yield gaps of existing crops mixes (promoting improved varieties (drought/heat/salinity tolerant species), improved inputs (fertilizers) and pest management
		Adopting improved livestock breeds and management (improved health, feeding practices etc.)
		Minimizing food loss and food waste through energy efficient cold storage, improved packing and sorting, and awareness raising campaigns.
		Improving soils management with a focus on reduced land degradation and soil salinity in agriculture via engineering, reclamation, and bio-chemical measures.
		Transitioning from marginal grains productivity areas towards high-return crops
		Sharing innovation among countries on climate smart practices and disruptive technologies (e-extension, e-agriculture, land use monitoring, remote sensing ET monitoring, hydroponics, vertical farming)
		Promoting energy efficient technologies and renewable energy in the agriculture and water sectors (solar power, wastewater reuse, biogas production from manure)

Institutional	Improving water allocation, efficiency, and productivity with demand management policies	Improving water accounting and dissemination of water information (water accounting, WSS indicators, and water quality data)
		Setting explicit priority sectors in extreme dry year and compensation measures for sectors with lower priority below a defined threshold
		Implementing economic policy instruments (pricing or quotas; and water reallocation plan within and across governorates)
	Repurposing agricultural support and policies	Revising and reforming the current public support mechanism, including subsidies, the Wheat and Barley Purchase Program and Public distribution system
		Establishing "smart incentives" programs for improved fertilizers, water and energy use
	Boosting financial sustainability, de-risking the water and ag sectors, and increasing private sector participation	Improved access to finance for small holders (soft loans and green financing)
		Guarantees to agri-business
		Implementing more efficient water subsidies and increased private sector participation
	Collaborating at regional level for water and agriculture sectors' resilience	Sharing information among countries for optimal management of water infrastructure and systems
		Improving water quality including monitoring and information sharing
		Establishing regional water research center and experts' panel from the riparian countries.
		Virtual water policy reform (agricultural and trade policies)
	Performing institutions and strategic communication with stakeholder	Establishing effective cross-sectoral and cross-governorate cooperation mechanisms
		Developing strategic knowledge exchange and communication with stakeholder
		Building capacity at the institutional level on climate-smart practices and investing in-country innovation ecosystem
		Improving preparedness to disasters (flood-droughts)
		Improving food reserves management (hedging, silos management, etc.)

Just Transition and a Resilient Economy

Table C5: Policy levers for just and resilient transition

Pillars	Policy Lever Recommendations	Activity
Labor Policies	Short-term passive labor transition policies	Temporary income support (e.g., severance pay; unemployment insurance or unemployment benefits/national safety net)
	Short-term active labor market policies	Connecting workers to potential employers (e.g., through job search assistance, soft skills training, mobility grants)
	Longer-term active labor market policies to train workers for jobs in sustainable industries and sustainable livelihoods.	Initiating training programs on climate-smart agriculture, agro-entrepreneurship, food-processing industries, green industry skills where there is existing demand (e.g., energy efficiency retrofitting, solar panel installation), PEI programs with an environmental services work component, entrepreneurship training to support business plan development and business management skills.
	Programs to stimulate private sector labor demand	Investment (fiscal) incentives, innovation grants, matching grant programs, incentives for firm partnership and mentoring); could have a spatially targeted focus.
		Improving water quality including monitoring and information sharing
	Labor regulations that foster labor mobility and promote firm agility to create jobs	Having less onerous severance rules (e.g., no third-party approval requirement) and more flexible rules on temporary contracts
Supporting Policies	Longer-term development policies that support human capital accumulation and labor productivity	Reforming school curriculum to build STEM skills for innovation and ICT, environmental/sustainability knowledge, promote entrepreneurship skills and related academic disciplines; mainstream problem-solving and soft skills across all academic disciplines; incorporate into primary education non-traditional gender careers and environmental awareness.
	Accountable transition finance	Investing in accountability measures to track climate finance, to see how it is reaching communities, improving reporting, and contributing to increasing policy ambition and mobilizing additional resources
	Programs to stimulate private sector labor demand	Investment (fiscal) incentives, innovation grants, matching grant programs, incentives for firm partnership and mentoring); could have a spatially targeted focus.
		Improving water quality including monitoring and information sharing
	Labor regulations that foster labor mobility and promote firm agility to create jobs	Having less onerous severance rules (e.g., no third-party approval requirement) and more flexible rules on temporary contracts

Dialogue	<p>Supporting local and national governments to convene multistakeholder groups to in areas affected by the transition towards greener energy mix and those affected by the adverse effects of climate change</p>	<p>Leveraging the social sustainability analytics and engaging CSOs, climate scientists, private sector, trade unions, women's groups, grassroot leaders, parliamentarians, religious leaders, students, etc.</p> <p>In areas that will be affected by the transition, promoting local adaptation and resilience of communities (both to physical and transition risks) will be essential. Proven mechanisms for locally-led climate action include community-driven development and devolved climate finance models.</p>
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Investing in Natural Capital

Table C7: Policy levers to promote natural resources-based sectors while protecting and sustainably managing Iraq's natural assets

Pillars	Policy Levers Recommendations and Actions
Measurement and Monitoring	<p>Measure and monitor natural resources-based wealth to boost sustainability and prosperity.</p> <ul style="list-style-type: none"> Measuring and monitoring wealth, alongside GDP. This would allow the Ministry of Finance to understand the important role of natural capital for national growth.³⁸ A review of the current government policies for natural resources management
Investments	<p>Invest in sustainable natural resources-based wealth.</p> <ul style="list-style-type: none"> Creating enabling conditions for balanced investments in sectors dependent on natural resources and ecosystems like agriculture, forestry, water and tourism. Investments and active government intervention to incentivize sustainable management and use Establishing property and use rights to prevent depletion or unsustainable conversion to other forms of capital. Correcting market failures to enable private investment in sustainable natural resources management and use Diversifying and rebalancing the asset portfolio to make growth resilient to external shocks.
Value-added Policies	<p>Create policy incentives to protect and increase the value of wealth.</p> <ul style="list-style-type: none"> Introducing policies to support sustainable natural resources management incentivizing value-enhancing investments while minimizing negative external effects. Assessing the risks to the natural resources base due to climate change must be an integral part of these policy efforts

Ensuring Greener and Resilient Cities

Table C8: Policy levers for urban resilience and green development in Iraqi cities

Pillars	Policy Lever Recommendations	Activity
Policy levers for urban resilience		
National planning policy reform	<p>Developing a comprehensive national planning guideline for climate resiliency</p> <ul style="list-style-type: none"> Review and revisit National Development Plan (NDP) 2018-2022 Review the projected/simulated climatic and environmental risks across cities and regions Identify risks hotspots and establish policy priorities for each city & urban center 	
	<p>Applying spatial planning</p> <ul style="list-style-type: none"> Revisit and review National Urban Strategy (NUS) framework Develop a vision and guidelines for urban development for each city & urban center Establish policy priorities and cross-sectoral solutions that can address the bottleneck of infrastructure provision 	

Climate-smart infrastructure development	Critical and targeted infrastructure interventions	<ul style="list-style-type: none"> Select/support infrastructure that is prioritized in the development plans that address emerging climatic and environmental risks Embrace multi-sectoral activities to ensure complementarity across sectors
	Adopting Nature-Based Solution	<ul style="list-style-type: none"> Develop a series of NBS options tailored to Iraqi contexts Implement a pilot NBS project to develop a business case Develop a road map of NBS implementation
	Developing Participatory and small-scale interventions	<ul style="list-style-type: none"> Promote community-participatory municipal service interventions to address local needs through participatory planning and budgeting Guide the plan under broader development objectives (e.g., city's development and CIP plans)
	Applying a climate lens to plan investment decision	<ul style="list-style-type: none"> Identify risks hotspots and design investment plan for targeted risks Assess potential climatic risks and vulnerabilities for investment portfolio
Enhancing institutional capacity and accountability	Supporting local and national governments	<ul style="list-style-type: none"> Develop organizational capacity both in federal and governorates to implement national policy priorities Establish an inclusive decision-making mechanism (e.g., community participation, private sector consultation) Conduct Institutional and financial assessment and review of authorizing environment at Ministerial, Governorate, and local levels
	Promoting the private sector's participation	<ul style="list-style-type: none"> Conduct diagnostics to improve enabling environment in Iraqi cities Develop innovative financing schemes such as investment (fiscal) incentives, innovation grants, matching grant programs, and firm partnership and mentoring incentives to mobilize green financing
Policy levers for promoting green urbanization		
Smart and green urban management	Promoting sustainable urban land-use and growth management	<ul style="list-style-type: none"> Monitor spatial growth of cities (i.e., urban morphology) and guide spatial development based on projected socio-economic trends Update planning and building regulation to promote efficient land use Develop incremental development plans aligned with short- and long-term goals of cities and governorates
	Adopting an efficient, sustainable, and inclusive urban transportation model	<ul style="list-style-type: none"> Develop a coordinated urban transportation model considering job market, residential location, and neighborhood characteristics. Prepare/update inclusive and affordable transportation planning
Circular economy and municipal service	Promoting circular economy through a municipal service program	<ul style="list-style-type: none"> Identify and prioritize municipal infrastructure investments Conduct assessments of institutional systems & organizational capacities regarding delivery of municipal services Provide a guidance to deliver urban infrastructure services as a critical enabler for low carbon transition
Building institutional capacities for governorates and municipalities	Implementing innovative method and approach	<ul style="list-style-type: none"> Adopt circular/resource-efficient approaches for urban services Implement technological solutions for energy/resource efficiency Leverage digital systems as part of effective disaster risk management systems Engage external partners/donors to mobilize green financing

Greening Finance and Unlocking Private Sector Potential

Table C9: Policy levers for green finance and private capital mobilization

Pillars	Policy Levers Recommendations and Actions
Institutional Assessment	<p>Gauge systematic vulnerabilities: CBI to run a comprehensive assessment of the sector exposure to climate-related risks by conducting scenario-based modelling given the imminent threat of rising temperature, increasing water scarcity, and meeting NDC targets. This assessment will enable CBI to identify highly at-risk financial institutions, probable stranded assets, and potential technological / capacity gaps.</p> <p>Incorporate “Green Factor” in balance sheets: CBI can support green financing by requiring financial institutions, those who are highly exposed to climate related physical and transition risks driven by excessive financing to</p>

	<p>SOEs, to hold more capital buffers and reserves. It also indirectly incentivizes market players to gradually lower their carbon-intensive investments.</p> <p>Build climate-friendly discipline: Introduce regular update on climate-related disclosure indicating funds allocation vis-a-via sectoral risk exposure of active financial institutions.</p>
Regulatory Support	<p>Develop “Green Taxonomy”: Developing a “green taxonomy” that clarifies to financial market participants what qualifies as green assets and activities is a growing trend and can help financial market participants consistently identify green investments in line with national priorities. Green taxonomy also aids in providing security to investors from greenwashing, promote sustainable friendly projects, open diversified investment opportunities, and increase FDI.</p> <p>Introduce green quantitative easing: Minimize public financing from carbon-intensive clients / industries. CBI can play a lead role by adopting climate-friendly practices in its asset purchases. This can be done by CBI providing monetary easing through climate-oriented capital instruments, such as Green Bonds, Climate Bonds, etc.</p> <p>Develop and implement a “Green Finance Framework”: Develop and implement a “Green Finance Framework” to assist the Iraqi Financial Sector in its contributions to meet Iraq’s NDC goals. This framework can outline specific financial policies, regulations, tools and instruments that provide transitional support for new green technologies. Policies should also be established to enable investment and strengthen market incentives for low carbon infrastructure. This can include creating fiscal incentives (e.g., tax breaks) for diversification into climate resilient sectors and adoption mitigation technologies, addressing tariffs and nontariff barriers on agricultural inputs and facilitate access to new technologies for farmers through expedited procedures for releasing seeds and easier movement of agricultural specialists, and support investments climate smart agriculture.</p>
Private Capital Mobilization	<p>De-risk private sector investments: Channel private sector investment and de-risk foreign direct investments through issuing Green Certificates (GCs) which would allow green project investors to repay a portion of their loans to commercial banks using such certificates. These certificates can be subject to CBI approving the feasibility of proposed projects as per their respective climate change driven goals.</p> <p>Mobilize international finance: Leverage domestic and international green finance, such as The Green Climate Fund, for harnessing resources and building capacity, promoting green business and consumer behavior. Blended finance could also be used to increase the leverage of the green components to support investment in renewable energy and in a whole host of related projects aiming at improving the environment and reducing the carbon footprint.</p> <p>Develop a green ecosystem: Proactively build supply-side financing support through greening banking sector, developing capital markets, and attracting green institutional investors. Similarly, drive demand generation by developing a transformative but realistic pipeline of green projects for 2022-2030, increasing private sector awareness and willingness to go green.</p>
Policy Planning	<p>Develop an Integrated Climate Change Strategy: It might be useful for the government to establish a climate change strategy that integrates all the vulnerable sectors, and an integrated climate change mitigation and adaptation action plan, taking into account the interdependences between sectoral actions, and clarifying the roles of various key stakeholders, including the private sector.</p> <p>Initiate public-private sector dialogue on climate change: It is important to create a platform for the public sector and private sector to share information and raise awareness about the current policies on current change, as well as enhance coordination of climate change intervention more effectively.</p>



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