

TERMS OF REFERENCE

Lead Technical Expert - Energy, Climate and Macroeconomic Modelling

1. Background

The GEMMES India project, funded by Agence française de Développement and implemented by Expertise France aims to strengthen NITI Aayog's capacity to assess the macroeconomic and financial implications of India's long-term development and energy-transition pathways. GEMMES-India is intended to complement NITI Aayog's existing suite of energy and climate modelling tools by enabling analysis of the interactions between economic growth, investment, employment, public and private finance, external balances, energy transition and other macroeconomic variables.

NITI Aayog already has detailed energy-system modelling capabilities, including the India Energy Security Scenarios (IESS) and TIMES models. These models have been used to develop long-term scenarios covering energy demand, technology deployment, emissions, investment requirements and sectoral transition pathways. Relevant scenario outputs will therefore be available as inputs to GEMMES-India and need not be redeveloped under this assignment.

The expert will work closely with NITI Aayog, the AFD GEMMES team, and the Expertise France team over a period of 24 months to support development, calibration, operationalisation and institutionalisation of GEMMES-India.

2. Objective of the Assignment

The overall objective of the assignment is to support NITI Aayog and AFD in developing an operational India-specific GEMMES model capable of assessing the macroeconomic and financial implications of India's development and energy-transition pathways. The NITI Aayog-AFD framework envisages GEMMES-India as an open-economy macroeconomic model capable of examining interactions between capital accumulation, public and private debt, under-employment, financial conditions, natural-resource constraints and distributional considerations. It also envisages linkages with detailed energy-system models such as TIMES.

The specific tasks related to the assignment include:

- Build a strong understanding within NITI Aayog of the GEMMES framework, model architecture and data requirements.
- Support development of a coherent and reproducible India-specific macroeconomic, financial and sectoral database for GEMMES-India.
- Support adaptation of the GEMMES model architecture and behavioural relationships to Indian economic conditions.
- Support calibration, validation and testing of GEMMES-India using historical Indian data.
- Facilitate integration of existing TIMES/IESS scenario outputs into GEMMES-India.
- Draw upon relevant climate adaptation analysis being undertaken separately within NITI Aayog, where useful for GEMMES-India.
- Support analysis of alternative development, energy-transition and financing scenarios.
- Strengthen NITI Aayog's institutional capacity to independently operate, update and further develop GEMMES-India.
- Contribute to the planning and implementation of activities, and monitoring of results in close collaboration with the Expertise France project team.

- Ensure the technical supervision of the project: prepare semi-annual work programs, pilot their implementation and oversee their timely execution.
- Prepare monitoring reports for Expertise France internal reviews (in January, April and September), covering activity plan implementation and achieved results.
- Contribute to technical reports to Agence française de Développement (one interim report and one final report), in coordination with the Expertise France project team.
- Facilitate the capitalization of project results and their dissemination to all stakeholders.

3. Scope of Work

The expert will work under the overall guidance of NITI Aayog and in close coordination with Expertise France and AFD's GEMMES technical team.

3.1 GEMMES-India model architecture

Support the adaptation of the GEMMES model to reflect the structure and characteristics of the Indian economy. This will include:

- undertaking technical familiarisation and training on the existing GEMMES framework, architecture, equations and modelling approach;
- reviewing GEMMES data requirements and identifying corresponding Indian datasets;
- supporting definition of the appropriate institutional and sectoral structure for India;
- identifying key India-specific macroeconomic relationships and transmission channels;
- supporting representation of households, firms, government, financial institutions and the external sector;
- supporting treatment of investment, capital accumulation, employment, wages, consumption, taxation, public expenditure, debt, trade, exchange rates and financial flows;
- reviewing behavioural assumptions and equations against Indian economic conditions and empirical evidence; and
- supporting documentation of major modelling choices and India-specific modifications.

The model should enable analysis of feedback between the real economy, financing conditions and energy-transition investment rather than treating GDP and financing conditions as purely exogenous.

3.2 Development of the GEMMES-India database

Support preparation of the historical database required for model calibration and operation. The database is expected to draw, as relevant, from:

- National Accounts and institutional sector accounts;
- Supply and Use Tables, Input-Output Tables and Social Accounting Matrix information;
- Flow of Funds and financial accounts;
- Balance of Payments, capital flows and trade in goods and services;
- employment, labour-force and wage statistics;
- prices and sectoral deflators;
- interest rates and financial-sector indicators;
- sectoral production and investment; and
- relevant energy and emissions variables.

The work will include mapping GEMMES variables to authoritative Indian data sources; developing the first consolidated GEMMES-India dataset; reconciling variables drawn from different statistical systems; identifying gaps, discontinuities and statistical discrepancies; constructing required derived variables and historical time series; integrating input-output and sectoral production information; preparing metadata and source documentation; and progressively developing reproducible data-processing procedures.

3.3 Calibration and validation of GEMMES-India

Support calibration and validation of the India model in collaboration with the AFD GEMMES team. Key tasks will include:

- supporting estimation and calibration of model parameters;
- reviewing equations against observed Indian macroeconomic relationships;
- conducting historical simulations and back-testing;
- examining model stability and sensitivity;
- documenting calibration assumptions and parameters;
- identifying areas where alternative specifications may be required;
- facilitating consultations with sectoral and macroeconomic experts; and
- incorporating agreed revisions following technical review.

The outcome should be a calibrated core GEMMES-India model capable of reproducing key historical macroeconomic relationships and serving as the basis for forward-looking policy scenarios.

3.4 Integration of existing TIMES/IESS scenarios

NITI Aayog will provide agreed outputs from its existing TIMES and IESS modelling exercises. The expert will support translation of these outputs into variables compatible with GEMMES-India.

Relevant inputs may include sectoral energy demand, electricity demand, fuel consumption, fossil-fuel imports, technology deployment, capital investment requirements, operating expenditure, energy-system costs, energy prices, emissions, energy-efficiency improvements, and retirement or replacement of existing assets.

The work will focus on determining how these physical and investment pathways enter GEMMES through capital formation, sectoral investment, domestic production, imports, household and government expenditure, energy prices, financing needs, employment and productivity.

Where required, supporting assumptions may be developed on domestic versus imported equipment, public versus private investment, financing structure, depreciation and asset life, implementation/gestation periods, and allocation of investment across sectors and institutional agents.

The assignment will support development of a reproducible TIMES/IESS-to-GEMMES interface. Relevant adaptation-related information generated through other ongoing NITI Aayog workstreams may also be drawn upon, where appropriate, to inform GEMMES assumptions and scenario analysis. The expert will coordinate with the concerned NITI Aayog adaptation team rather than undertake a separate adaptation-costing exercise.

3.5 Scenario and policy analysis

Support application of GEMMES-India to a set of policy-relevant scenarios agreed jointly by NITI Aayog and AFD. The framework should permit analysis across combinations of baseline/development pathways, existing TIMES/IESS energy-transition pathways, alternative investment requirements and financing strategies.

Financing scenarios may include, as appropriate, domestic private finance, domestic public finance, commercial borrowing, concessional international finance, grants and climate transfers, green bonds and other debt instruments, combinations of domestic and international finance, and alternative cost-of-capital assumptions.

Where relevant, outputs from NITI Aayog's separate adaptation work may be incorporated as additional investment or expenditure assumptions for selected scenarios.

The model should be capable of reporting implications for GDP and sectoral output, investment, household consumption, employment and wages, inflation, public revenue and expenditure, fiscal deficit, public and private debt, trade and current-account balances, capital flows, energy imports, energy-transition investment and emissions. The special focus will be on implications on the banking system including monetary policy dimensions.

4. Deliverables and Indicative Timeline

The assignment will be undertaken over 24 months, with key deliverables produced every three months.

Timeline	Deliverable	Key Outputs
Month 3	D1: GEMMES Technical Familiarisation, Model Architecture and India Data Mapping	• Technical training and familiarisation on GEMMES architecture, equations and modelling approach. • Review of the existing GEMMES structure and identification of India-specific modelling requirements. • Preliminary definition of institutional and sectoral structure for GEMMES-India. • Detailed mapping of GEMMES variables to Indian datasets and relevant data-owning institutions. • Mapping of available TIMES/IESS outputs relevant for GEMMES integration. • Identification of critical data gaps and data-quality issues. • Detailed work plan for subsequent model and database development.
Month 6	D2: First Draft of GEMMES-India Dataset	• First consolidated GEMMES-India dataset covering key macroeconomic, fiscal, financial, external-sector, labour and sectoral variables. • Documentation of data sources and definitions. • Preliminary reconciliation of variables across different datasets. • Identification of remaining data gaps, inconsistencies and statistical discrepancies. • Initial mapping of Input-Output, Supply-Use Table and SAM datasets. • Preparation of metadata and data dictionary. • Plan for subsequent data refinement, harmonisation and automation.

Timeline	Deliverable	Key Outputs
Month 12	D3: Core GEMMES-India Prototype	• First operational GEMMES-India model prototype. • Development of the core accounting framework. • Implementation of principal behavioural equations. • Preliminary model calibration. • Historical simulation of key macroeconomic variables. • Initial diagnostic assessment of model performance. • Technical note documenting model structure, equations, assumptions and outstanding data/model gaps.
Month 15	D4: Calibrated GEMMES-India Core Model	• Revised and reconciled GEMMES-India database. • Calibrated macroeconomic and financial model. • Historical back-testing of key model relationships. • Sensitivity analysis of major model parameters. • Development of baseline/reference economic trajectory. • Technical review with NITI Aayog and AFD. • Incorporation of revisions arising from technical review.
Month 18	D5: Energy-Transition Integration	• Mapping of energy-transition investments into relevant macroeconomic channels. • Integration of energy imports, energy costs and other relevant energy-system variables. • Development of required bridging assumptions between energy-system and macroeconomic models. • First demonstration simulations using agreed TIMES/IESS scenarios.
Month 21	D6: Integrated GEMMES-India Model - Beta Version	• Integrated macroeconomic and energy-transition model. • Reproducible TIMES/IESS-to-GEMMES interface. • Representation of alternative public, private and external financing mechanisms. • Incorporation, where relevant, of adaptation-related inputs generated through NITI Aayog's parallel adaptation work. • Integrated scenario simulations. • Interim technical documentation of the integrated model.
Month 23	D7: Policy Scenario Assessment	• Finalisation of agreed development, energy-transition and financing scenarios. • Comparative assessment of macroeconomic outcomes across scenarios. • Analysis of fiscal, employment, debt and external-sector impacts. • Sensitivity and stress testing of major assumptions. • Preparation of draft technical report. • Preparation of draft policy findings. • Stakeholder and technical consultation on results.

Timeline	Deliverable	Key Outputs
Month 24	D8: Final GEMMES-India Model and Handover	• Final calibrated and validated GEMMES-India model. • Final GEMMES-India database. • Final TIMES/IESS integration interface. • Technical documentation of model architecture, assumptions and calibration. • Final technical report and policy brief. • Training and knowledge-transfer sessions. • Final technical seminar/workshop.

5. Working Arrangements and Responsibilities

The expert will be based at NITI Aayog, New Delhi, and work as part of the NITI Aayog team while coordinating closely with AFD's GEMMES technical team.

- support day-to-day coordination of the GEMMES-India work programme;
- act as a technical interface between NITI Aayog and the AFD modelling team;
- coordinate access to and interpretation of Indian datasets;
- facilitate interaction with NITI Aayog's TIMES/IESS modelling teams;
- coordinate with other relevant NITI Aayog, DEA, MoEFCC and RBI teams, including teams working on climate adaptation, where their analytical outputs are relevant to GEMMES;
- coordinate inputs from relevant ministries, agencies and technical institutions;
- support review and validation of modelling assumptions;
- organise or participate in regular technical meetings and workshops;
- assist in preparation of policy notes, technical reports and presentations; and
- support dissemination of results through agreed NITI Aayog/AFD platforms, including ICEMF where relevant.

AFD's GEMMES team will provide technical guidance and training on GEMMES architecture and model development.

6. Capacity Building and Knowledge Transfer

A key objective of the assignment is to institutionalise GEMMES modelling capability within NITI Aayog. The expert will therefore participate in and support continuous knowledge transfer throughout the assignment, including:

- understanding GEMMES architecture and equations;
- database construction and updating;
- data reconciliation and quality checks;
- model calibration and scenario design;
- integration of TIMES/IESS outputs;
- sensitivity analysis and interpretation of model results; and
- preparation of policy-relevant analysis.

By the end of the assignment, NITI Aayog and other identified stakeholders as recommended by NITI Aayog should have the capability to independently run and update the model and progressively modify or extend selected components.

7. Minimum Qualifications and Professional Experience

Minimum Educational Qualification

At least a Master's degree in Public Policy, Economics, Development Economics, Public Administration, Energy Policy or a related discipline from a reputed national or international institution.

Professional Experience

- at least 12 years of relevant professional experience in public policy, energy, climate change, economic analysis or development planning;
- demonstrated experience in energy and climate modelling, including development, application or coordination of models such as IESS, TIMES/TIMES-VEDA or comparable long-term modelling frameworks;
- strong understanding of India's energy transition and the Government of India policy and institutional ecosystem;
- experience in multidisciplinary analytical work involving government, modelling institutions, development partners and other stakeholders; and
- strong analytical, strategic thinking, quantitative, stakeholder-management and communication skills.
- experience with macroeconomic modelling, climate finance or linking energy-system models with macroeconomic frameworks would be an advantage.

8. Technical and Financial Proposal

Candidates shall submit:

- a detailed CV highlighting relevant experience and availability;
- a concise technical proposal, of no more than two pages, presenting their understanding of the assignment and proposed methodology;
- references for comparable assignments; and
- a financial proposal indicating the proposed daily fee inclusive of all applicable taxes.

9. NITI Aayog Support Team

A dedicated NITI Aayog team will support implementation of GEMMES-India and will work under the technical guidance of the expert for project-related activities. The core support team will comprise four members:

- energy Modelling Team (2 specialists): Specialists currently engaged in the development and application of IESS and TIMES scenarios. They will support provision and interpretation of existing energy-system scenarios, assumptions and datasets; mapping of model outputs to GEMMES; development of the TIMES/IESS-to-GEMMES interface; and analysis of sectoral energy-transition pathways.
- climate Finance Team (2 specialists): Team members working on climate finance and investment analysis. They will support development of financing assumptions and scenarios, including public and private finance, concessional and external finance, cost-of-capital considerations, investment requirements and relevant macro-financial data and analysis.
- the expert will guide task allocation across the support team, review and integrate technical outputs, and build the team's capacity to operate and further develop GEMMES-India.
- other NITI Aayog teams and external government stakeholders, including the team undertaking adaptation-related analysis, may be engaged as required for specific data, assumptions or scenario inputs.

10. Other relevant information

The assignment may require participation in technical workshops, consultations and missions within India and, where agreed by NITI Aayog and AFD, international technical meetings or missions.

This part-time position consists in a maximum number of 440 men/days over 24 months. Beginning of activities is expected in November 2026.