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# Integrated Energy System Planning and Least-Cost Expansion Training Course

22 – 26 August 2027  
Muscat





## Integrated Energy System Planning and Least-Cost Expansion Training Course

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### Programme Summary

Integrated energy system planning and least-cost expansion is a five-day training course for ministry, regulator and utility planning leaders at strategic level, culminating in an energy plan brief that sets out a preferred expansion pathway for their own system. Energy plans commit public and private capital for decades, yet many are built on weak demand forecasts or narrow technology choices that leave systems costly, insecure or off track for sustainable development goals. The approach links demand, supply, reliability, environment and finance in one planning cycle. Mars Training Centre UK delivers this programme in integrated energy system planning.

### The Business Case

Planning decisions on generation, fuel supply and networks shape tariffs, public budgets and emissions long after they are made. When forecasts are not tested, least-cost options are not compared on a common basis or reliability targets are left vague, organisations face stranded assets, supply shortfalls or expensive emergency procurement.

- System Cost: Falls as expansion options are compared on a least-cost basis across technologies and fuels.
- Supply Security: Improves as reserve margins, fuel diversity and reliability targets are built into every plan.
- Policy Credibility: Rises as plans show transparent scenarios, sustainable development targets and financing routes.

### Principles and Evidence Base

- Energy Balances and the MAED Demand Model: Structure the demand analysis and forecasting in Session 1 and Session 2.
- Least-Cost Optimisation with the MESSAGE Model: Frames supply and capacity expansion choices in Session 3.
- Integrated Resource Planning IRP: Provides the repeatable process for comparing supply and demand-side resources in Session 3 and Session 4.
- SDG 7 and Long-Term Energy Scenarios: Anchor environmental targets and scenario analysis in Session 4.



## Intended Participants

- Leaders who own national or regional energy plans and investment programmes.
- Managers responsible for utility generation, network or fuel supply expansion plans.
- Regulatory leaders who review plans, approve investments or set reliability standards.
- Strategy heads in national oil, gas and power companies who align corporate plans with national targets.

The programme serves energy ministries and agencies, electricity and gas regulators, power and water utilities, and national oil and gas companies.

## Learning Outcomes

1. Participants will be able to construct an energy balance and evaluate the quality of planning data.
2. Participants will be able to diagnose weaknesses in demand forecasts and test them against economic and policy drivers.
3. Participants will be able to compare supply and capacity expansion options on a least-cost basis.
4. Participants will be able to assess plans for supply security, reliability and environmental targets.
5. Participants will be able to justify a preferred pathway using scenarios, financing and policy instruments.
6. Participants will be able to prepare an energy plan brief for decision makers.

## Programme Structure

### Day 1: Integrated Energy System Planning Foundations

What does an integrated planning cycle need, and how reliable is the starting data?

- Energy Planning Cycle and Institutional Roles
- Energy Balances and Flow Diagrams
- Planning Data Sources and Quality Checks
- Sustainable Development Goals and SDG 7 Targets
- Baseline Review of Current Plans

### Day 2: Energy Demand Analysis and Forecasting

How much energy will each sector need, and how certain is that forecast?

- Sectoral Demand Drivers and End-Use Analysis
- MAED Demand Modelling Approach
- Econometric and Trend Forecasting Methods
- Load Curves and Peak Demand Projection
- Demand-Side Management and Efficiency Potential



## Day 3: Least-Cost Supply and Capacity Expansion

Which mix of supply options meets demand at the lowest total system cost?

- Supply Option Characterisation and Screening Curves
- MESSAGE Least-Cost Optimisation Principles
- Generation, Fuel Supply and Network Expansion
- Integrated Resource Planning Process
- Renewable Integration and Flexibility Needs

## Day 4: Security, Environment and Scenarios

How robust is the preferred plan to risk, policy change and environmental limits?

- Reserve Margin and Loss of Load Expectation
- Fuel Diversity and Energy Security Indicators
- Emissions Pathways and Environmental Constraints
- Long-Term Energy Scenario Design
- Plan Financing and Investment Programming

## Day 5: Applying the Energy Plan Brief

How is planning evidence turned into a decision and a policy route?

- Pathway Comparison for a Participant System
- Risk and Sensitivity Review of the Preferred Plan
- Policy Instruments and Implementation Sequencing
- Peer Challenge of Planning Assumptions
- Energy Plan Brief Presentation

## Methodology

The programme relies on case analysis supported by structured planning exercises. Participants work through energy balances, demand projections and expansion results from power, gas and oil systems, compare pathways under different scenarios and test how financing and policy choices change the preferred plan.

- Suggested activity: Building a simplified energy balance from national statistics.
- Suggested activity: Ranking supply options with screening curves before full optimisation.
- Suggested activity: Testing a preferred plan against a high-demand and a low-carbon scenario.



## Capstone Output

Each participant prepares an energy plan brief for their own system. It summarises demand outlook, compared expansion pathways, security and environmental tests, financing needs and the recommended policy route, in a form ready for ministers, boards or regulators.

## Frequently Asked Questions

### **Is integrated energy system planning suitable for leaders who do not run planning models?**

Yes. It suits leaders who commission, review or approve energy plans. It assumes energy sector experience but no modelling skills, and focuses on reading and challenging model results.

### **Which models underpin integrated energy system planning?**

It draws on energy balances, the MAED demand model, the MESSAGE least-cost optimisation model, integrated resource planning and long-term energy scenarios linked to SDG 7.

### **How is the integrated energy system planning brief used at work?**

You take back a brief that sets out a preferred expansion pathway, its risks and financing, ready to support a ministerial, board or regulatory decision.

### **How does integrated energy system planning differ from energy transition strategy programmes?**

It concentrates on the quantitative planning process behind demand, supply and reliability decisions, rather than corporate strategy or technology overviews.