

WORKPROGRAMME FOR ANNEX XVI

ANNEX XVI: ALIGNING ENERGY SECURITY WITH ZERO EMISSIONS ENERGY SYSTEMS

SUMMARY

The analysis of achieving Net Zero GHG emissions energy system has become the main topic in energy system analysis, as countries seek to deliver on the Paris Agreement. The topic of energy security became a very live issue geopolitically in the year 2022, after receiving a relatively lower focus of attention in recent decades. This reinforces the need to align the dual goals of achieving energy security and net zero emissions energy systems. This requires the exploration of new and very different energy system in the future that will meet societal needs for energy services, while also addressing the critical issues related to climate change, broader economic and environmental sustainability, and energy security.

A joint international programme of energy systems analysis is now even more necessary than forty years ago, when the ETSAP TCP was created under the aegis of the International Energy Agency (IEA) in response to the pressures arising from the first oil crisis. Decision makers need robust policy analyses that encompass the relevant global, regional national and local factors with increasing detail. In order to assess the contribution of new technological options, the key technologies need to be identified and the policies that can bring them to the market should be defined. Therefore, analytical tools that examine the integrated energy system operation, including environment, energy security and economics, are essential to increase the evidence base underpinning these policies. This ETSAP Annex XVI Work Programme will provide experts, tools and analyses to meet this policy need.

Duration: 2023 - 2025

OBJECTIVES:

(a) *Tools Maintenance, Improving and Capacity Building*

ETSAP Tools and Methodologies development and maintenance for the long term analysis of the energy, economy, environment interactions, is the minimum objective of this Annex.

1. Maintenance, update and improvement of TIMES is the minimum objective of the Annex, together with the development of user interfaces (for data input to the TIMES / MARKAL models, and analysis of the model results);
2. Increasing the transparency, openness and affordability of the TIMES model generator, associated software and data sets.

3. Maintenance, extension and improvement of international and national capabilities on the use of ETSAP' tools, across developed and developing countries; and
4. Availability of online user's support systems including tutorials, user's forums, manuals and reference material.
5. Building capacity through training courses (including online training options), updating the documentation

(b) *Research and Development*

ETSAP will support research and development activities in order to advance the state-of-the-art of energy systems analysis. A non-exhaustive list of topics includes:

1. Interaction of energy systems with materials use, with a particular focus on critical minerals and agriculture;
2. Integrate issues of sustainability of biomass in the analyses (e.g. biomass GHG overshoot problem);
3. Improved modelling of the consumption side of energy systems, demand side flexibility, integrating societal aspects into energy systems modelling;
4. Improved modelling of the interactions between the energy system and social systems, structural changes, and circular economy;
5. New approaches to energy security and energy resilience;
6. Continued development and improvement of the Global Integrated Assessment ETSAP-TIAM model

In addition, ETSAP will explore and develop collaboration opportunities with IEA and IRENA building on and deepening existing collaboration.

Budget: Each Contracting Party contributes with an annual fee of €20,000 the first year and not more than that in the following years. Sponsors will contribute with an annual fee of €30,000 the first year and not more than that in the following years. The Executive Committee will decide the annual budget, and thereby the participation fee taking into accounts the number of participants.

Operating Agent:

The Institute for Energy Technology (IFE), Norway.

Annex XVI (2023-2025)***TITLE: ALIGNING ENERGY SECURITY WITH ZERO EMISSIONS ENERGY SYSTEMS*****1. Introduction**

The analysis of achieving Net Zero GHG emissions energy system has become the main topic in energy system analysis, as countries seek to deliver on the Paris Agreement. The use of biomass and the sustainability of biomass which is used, the coupling of energy systems with material use (in particular critical minerals), land use, and agriculture are only some of the topics which are important to understand in order to explore the plausibility of achieving the environmental targets. A joint international programme of energy systems analysis is now even more necessary than forty years ago, when the ETSAP TCP was created under the aegis of the International Energy Agency (IEA) in response to the pressures arising from the first oil crisis.

The topic of energy security became a very live issue geopolitically in the year 2022, after receiving a relatively lower focus of attention in recent decades. This reinforces the need to align the dual goals of achieving energy security and net zero emissions energy systems. This requires the exploration of new and very different energy system in the future that will meet societal needs for energy services, while also addressing the critical issues related to climate change, broader economic and environmental sustainability, and energy security.

Decision makers need robust policy analyses that encompass the relevant global, regional national and local factors with increasing detail. In order to assess the contribution of new technological options, the key technologies need to be identified and the policies that can bring them to the market should be defined. Therefore, analytical tools that examine the integrated energy system operation, including environment and economics, are essential in increasing the evidence base underpinning these policies.

ETSAP is well equipped to provide experts and tools for these analyses.

2. Objectives

Acknowledging that ETSAP tool users independently offer to national and international organizations their capabilities of contributing to climate change mitigation analysis, building energy models, compiling scenarios, and conducting analyses, the Contracting Parties to this Implementing Agreement participating in this Annex aim at carrying out the following range of cooperative activities for their mutual benefit and to support their independent activities.

(a) *Tools Maintenance, Improving and Capacity Building*

Maintaining and improving ETSAP Tools and methodologies and capacity building on the use of these tools, is the minimum objective of this Annex. This activity includes:

1. Maintenance, update and improvement of TIMES model generator. TIMES will be improved from the methodological point in order to include the specific aspects that are needed in the analysis of the future energy system. Maintenance of MARKAL model generator is not foreseen; in order to ensure that the needs of current MARKAL users are covered, the tool will continue to be available, but TIMES will be promoted actively.
2. Increasing the transparency, openness and affordability of the TIMES model generator, associated software and data sets. TIMES is already available under a GPL v.3.0 license. A TIMES-MIRO interface has been developed and could be used as a simple interface with TIMES models.
3. Currently only VEDA2.0 is actively developed as a model interface used for:
 - a. data input to the TIMES models, and
 - b. analysis of the model results.

Therefore, VEDA2.0 is extremely important in facilitating the work of energy modellers. It will be continuously enhanced to follow the updates of TIMES and the related documentation will be revisited frequently in order to assist new users to get acquainted with them.

4. Capacity building aims to maintaining, extend and improve international and national capabilities, across developed and developing countries, for
 - The proper use of ETSAP Tools (TIMES, VEDA), through the improvement of the users' and "getting started" manuals as well as demo models and "getting started" models;
 - Enhanced capabilities for energy systems analysis incorporating technological and market issues by building consistent energy / engineering / economic / environment scenarios;

- Regular provision of training courses (at least two per year together with the semi-annual workshops) including online training options as required. Advanced training courses on the use of VEDA/TIMES will also be planned. The Tosato grant, which covers the travel and subsistence expenses of trainees from low- and middle-income countries will continue in the next term, to enable these trainees participate in the training sessions and in the semi-annual workshops.
 - Modelling a range of possible long term development paths with ETSAP tools, and
 - Under-pinning and evaluating energy related policies focusing on the future transition of the energy system.
 - Collaborate with non-OECD countries for the development of NDCs focussing in the post-Paris targets and commitments.
5. The documentation is important for new and existing users, so one of the main priorities will be the continuous update and enhancement of the existing documentation material to include new features and to be more user friendly (especially for new users).
6. Availability of online web support systems will be further developed with online user's support systems including tutorials, user's forums, manuals and reference material.
- (b) *Research and Development*
- ETSAP will support research and development activities that continually advance the state-of-the-art of energy systems analyses and integrated energy / economic / environmental / engineering modelling, to the extent that available common funds allow. The following is non-exhaustive list of topics that can be explored:
1. Interaction of energy systems with materials use, with a particular focus on critical minerals and agriculture.
 2. Integrate issues of sustainability of biomass in the analyses (e.g. biomass GHG overshoot problem).
 3. Improved modelling of the consumption side of energy systems, demand side flexibility, integrating societal aspects into energy systems modelling.

4. Improved modelling of the interactions between the energy system and social systems, structural changes, and circular economy.
5. New approaches to energy security and energy resilience.
6. Continued development and improvement of the Global Integrated Assessment ETSAP-TIAM model.

(c) Engagement with the decision makers on energy and environmental policy issues and engagement with IEA, the other Technology Collaboration Programmes, IRENA and others aiming at deeper collaboration on issues of common interest.

3. Means

The Participants shall achieve the objectives through the following means:

- (a) Carrying out common analyses on key aspects of present energy technology systems and their possible future developments;
- (b) Collecting, analysing and disseminating information and consistent data related to energy systems, energy technologies, energy and environment models and scenarios;
- (c) Promotion of common research on energy systems analysis, integration of existing tools in the present methodology and development of new tools, together with other groups active in the field;
- (d) Enhancement of existing ETSAP Tools and implementation of new ones, also by linking ETSAP methodology to other approaches;
- (e) Improvement of ETSAP Tools documentation and dissemination of representative analyses carried out with them;
- (f) Organization of semi-annual meetings of experts, as appropriate, to exchange information and experience in the area of work covered by the Agreement;

- (g) Participation in joint meetings with other IEA TCPs or related international projects, making a concerted effort to communicate with the wider professional community, and by otherwise involving decision-makers;
- (h) Promotion of, and participation to, relevant common projects;
- (i) Organization of training courses to inform new experts or to widen the analytic capabilities of existing experts domestically, locally and in outreach activities, including “in-reach” capability building for participants in the use of the global models;
- (j) Exchange of specialists, experts and students active in the sector;
- (k) Using national and multi-national reference groups for the development and analysis of the models and linkage to users;
- (l) Twinning established ETSAP Contracting Parties with new countries, providing materials to guide new and recent users of ETSAP methodologies, as part of “Outreach” initiatives; and
- (m) Carrying out such other activities as may be agreed in the Annual Programme of Work.

4. Deliverables

The Participants shall achieve the objectives through the following deliverables:

- (a) Books, peer reviewed publications in journals and conference proceedings;
- (b) Publications of independent analyses and background material resulting from the studies carried out towards the achievement of the above objectives; this could materialise in a common report / book as well as contributions to journals and other reports;
- (c) Technical reports on the feasibility or actual extension of ETSAP tools in general to neighbouring fields;
- (d) Updated common tools for energy systems analysis, including improved versions of users’ manuals and guides for the use of ETSAP tools;

- (e) An improved website to better support the global community of ETSAP Tool users, including a password protected area with models and data accessible only to Contracting Parties and others approved by the Operating Agent / Executive Committee;
- (f) Periodic reports on workshops or seminars, and on analytical studies undertaken in connection with the Annex; and
- (g) Annual reports and a final report on the activities carried out under this Annex.

5. Specific Obligations, Responsibilities and Rights of the Participants

Participants shall carry out, to the extent possible, the following activities and communicate the results to the Operating Agent:

- (a) Performance of global, multi-regional, national and local scenario studies using ETSAP Tools energy systems analyses in general;
- (d) Participation to the development of ETSAP models and Tools, including testing of newly developed versions of software, as well as reviewing the deliverables of the projects which are funded by ETSAP, and
- (e) Contribution to the efforts of disseminating the methodologies and their use in assessing local, national, regional or global systems, offering lessons and courses, carrying out “Outreach” activities.

Participants have special rights to the results of the joint work, not available to non-participants, as may be decided by the Executive Committee, subject only to the limitations laid out in paragraph 10 below. This includes privileged access to ETSAP Tools, the support systems and related services contracted on behalf of ETSAP or made available to Participants by the Operating Agent acting on decisions taken by the Executive Committee. This includes:

- (a) Small group (5-user) license to the ANSWER and VEDA model management systems for MARKAL and TIMES;
- (b) Access to ETSAP models at no charge;

- (c) Discounted fees for the GAMS language in which the MARKAL and TIMES model generators are written for own and Outreach purposes (if possible); and
 - (d) Participation free of charge to the training courses organised by ETSAP.
- 6. Specific Obligations and Responsibilities of the Operating Agent**

In addition to the obligations and responsibilities enumerated in Article 4 of the Implementing Agreement, the Operating Agent shall perform or engage in the activities noted below.

(a) Establish the Project Staff

For the purpose of carrying out the above objectives and to fulfil this program of work the Operating Agent shall establish a project staff and such additional assistance as may be required, including external staff.

(b) Prepare the Program of Work and Reports

The common program of work will be proposed by the Operating Agent for approval by the Executive Committee. The common work may be performed by the Project Head, other Operating Agent staff, or organizations or professionals designated by the Operating Agent, according to the work plan(s) established by the Executive Committee.

The Operating Agent shall submit yearly to the Executive Committee a draft Programme of Work, with an accompanying task-level budget, for the following year. The Operating Agent shall report yearly to the Executive Committee on the progress of the activities under each task. The Project Head will assist the Operating Agent to the follow up and planning of the work programme activities.

Upon completion of this Annex, the Operating Agent shall prepare and submit to the Executive Committee for approval a draft final report on the activities carried out during the period of this Annex. Following approval, the Operating Agent shall transmit the report to the IEA secretariat and to the members of the IEA Committee on Energy Research and Technology.

The Committee on Energy Research and Technology may, during this Annex, propose additions to the Programme of Work. The Executive Committee shall decide whether these proposals will be added to the Programme of Work, provided such additional work can be

carried out within the resource levels set out in paragraph 9 below, or other sources of funding is secured.

(c) *Coordinate the Task and Manage the Program of Work*

The Operating Agent shall bear the following main responsibilities:

- (1) To manage the agreed upon common program of work;
- (2) To supervise the maintenance of the ETSAP tools;
- (3) To assure appropriate communication among the Participants;
- (4) With the approval of the Executive Committee, to represent ETSAP in various international conferences, bodies, and groups;
- (5) To prepare and distribute material on the work of ETSAP through the Internet.
- (6) In co-ordination with the Participants, to use its best efforts to avoid duplication of activities with other related programmes and projects implemented by or under the auspices of the IEA or of other competent bodies;
- (7) To provide the Participants with the necessary guidance for the work they carry out, assuring minimum duplication of effort;
- (8) At the request of the Executive Committee, to organize workshops and seminars; and
- (9) At the request of the Executive Committee, to co-ordinate the work of a small group of experts charged with reviewing the consistency and accuracy of input data, national models, and the main findings.
- (10) Delegate any of the points above to the Project Head.

The Project Head will:

- (1) Encourage more participation of the existing Contracting Parties.
- (2) Contribute to the enlargement of the ETSAP community by seeking new potential contracting parties and sponsors.
- (3) Contribute the execution of the work programme in collaboration with the Operating Agent as described above.

7. Operating Agent

The Institute for Energy Technology (IFE), Norway is designated as the Operating Agent.

8. Time Schedule

This Annex shall enter into force on January 1, 2023 and shall remain in force till December 31, 2025. Within the limits of the term of the Agreement, this Annex may be extended by two or more

Participants, acting in the Executive Committee, and shall thereafter apply only to those Participants. Notwithstanding this provision, in the event that the Implementing Agreement expires or is terminated before this Annex is set to expire, this Annex will automatically terminate as of the date that the Implementing Agreement expires/terminates.

9. Funding

(a) *Common Financial Obligations*

The Common Program will be funded by contributions by the Participants and managed by the Operating Agent. The actual costs of the Common Program during this Annex will be divided equally among all Participants. If the number of Participants changes, the Executive Committee will decide whether or not to adjust the budget and the annual fees.

The annual fee for 2023 is to be €20,000 per participant, and not more in the following years. The Executive Committee will decide the annual budget taking into account the number of participants. The Executive Committee will decide the annual budget for subsequent years, taking into account the actual number of Participants, inflation and any agreed changes in the Common Program.

(b) *Individual Financial Obligations*

In addition to the contributions set out in subparagraph (a) above, each Participant shall bear all costs associated with carrying out this program of work, including the costs of its national team to carry out the program and their participation in workshops and seminars.

(c) *Additional contribution*

Any fees collected for carrying out training programs, will add to the ETSAP budget.

Voluntary contributions from participants and other possible sponsors, if any, are welcome and will be used to more actively pursue the objectives and goals for the program of work, as approved by the Executive Committee.

ETSAP may provide seed money for (large) capacity building and analysis projects, to be decided on a case-by-case by the Executive Committee. In addition the Operating Agent and the Contracting Parties are urged to seek funding sponsors ready to co-finance projects for training and analysis based on ETSAP tools, similarly to what presently happens with competing modelling tools.

With the approval annually of the Executive Committee, ETSAP will continue to be a sponsor of the International Energy Workshop, where ETSAP partners have continually been contributors and participants.

10. Information and Intellectual Property

(a) *Executive Committee Powers*

The publication, distribution, handling, protection and ownership of information and intellectual property arising from this Annex shall be determined by the Executive Committee, acting by unanimity, in conformity with this Agreement.

(b) *Right to Publish*

Subject only to copyright restrictions, the Participants shall have the right to publish all information provided to or arising from this Annex except proprietary information, but they shall not publish it with a view to profit, except as agreed by the Executive Committee, acting by unanimity.

(c) *Proprietary Information*

The Operating Agent and the Participants shall take all necessary measures in accordance with this Annex, the laws of their respective countries, and international law to protect proprietary information. For the purposes of this Annex proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example, computer programmes, design procedures and techniques, chemical composition of materials, or manufacturing methods, processes, or treatments) that is appropriately marked, provided such information:

- (1) Is not generally known or publicly available from other sources;
- (2) Has not previously been made available by the owners to others without obligation concerning its confidentiality; and
- (3) Is not already in the possession of the recipient Participant without obligation concerning its confidentiality.

It shall be the responsibility of each Participant supplying proprietary information to identify the information as such and to ensure that it is appropriately marked.

(d) *Production of Relevant Information by Governments*

The Operating Agent should encourage the governments of all IEA Participating Countries to make available or to identify to the Operating Agent all published or otherwise freely available information known to them that is relevant to the program of work. The Participants should notify the Operating Agent of all pre-existing information, and information developed independently of the program of work known to them which is relevant to the Annex and which can be made available to the Annex without contractual or legal limitations.

(e) *Production of Available Information by Participants*

Each Participant agrees to provide to the Operating Agent all previously existing information and information developed independently of the Annex which is needed by the Operating Agent to carry out its function in this Annex and which is freely at the disposal of the Participant and the transmission of which is not subject to any contractual and/or legal limitations:

- (1) If no substantial cost is incurred by the Participant in making such information available, at no charge to the Annex, and
 - (2) If substantial costs must be incurred by the Participant to make such information available, any such charges to be reimbursed from the Annex as shall be agreed between the Operating Agent and the Participant with the approval of the Executive Committee.
- (f) *Use of Proprietary Information*
- If a Participant or ETSAP collaborating institution has access to proprietary information which would be useful to the Operating Agent in conducting studies, assessments, analyses, or evaluations, such information may be communicated to the Operating Agent in accordance with an agreement between the Operating Agent and the specific Participant/collaborating institution setting forth the terms and conditions for such acceptance, but the proprietary information shall not become part of reports, handbooks, or other documentation, nor be communicated to others except as may be agreed in writing between the Operating Agent and the Participant/collaborating institution which supplied such information.
- (g) *Acquisition of Information for the Annex*
- Each Participant shall inform the Operating Agent of the existence of information known to the Participant that can be of value to the Annex, but which is not freely available, and the Participant shall endeavour to make the information available to the Annex under reasonable conditions, in which event the Executive Committee may, acting unanimously, decide to acquire such information.
- (h) *Reports on Work Performed under the Task*
- The Operating Agent shall provide reports to the Participants and to the Executive Committee on all work performed under the Annex and the results thereof, including studies, assessments, analyses, evaluations and other documentation, but excluding proprietary information.
- (i) *Copyright*
- The Operating Agent may take appropriate measures necessary to protect copyrightable material generated under this Annex. Copyrights obtained shall be the property of the Operating Agent in trust for and for the benefit of the Participants, provided, however, that Participants may reproduce and distribute such material, but shall not publish it with a view to profit, except as otherwise directed by the Executive Committee.
- (j) *Authors*
- Each Participant shall, without prejudice to any rights of authors under its national laws, take necessary steps to provide the co-operation with its authors required to carry out the provisions of this paragraph. Each Participant will assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

(k) *Intellectual Property Rights held by ETSAP*

The Operating Agent, in trust for and for the benefit of the Participants, as directed by the Executive Committee, holds the Intellectual Property Rights of:

- the MARKAL and TIMES model generators;
- the official version of ETSAP-TIAM;
- the Energy Technology Data Source, E-TechDS;
- the two web sites: www.etsap.org and www.iea-etsap.org; and
- the ETSAP final reports and Newsletters.

(l) *Assignment of ETSAP IPR to another organisation*

With a majority vote, the Executive Committee can assign such rights to another organisation based on future events.

(m) *New Intellectual Property Rights*

New IP created during this Annex will be held by the Operating Agent, in trust for and for the benefit of the Participants, as directed by the Executive Committee.

(n) *Use of ETSAP logo and Disclaimer*

The following holds related to the ETSAP logo:

1. Contracting parties presenting their work which has utilized ETSAP tools can use the ETSAP logo together with the disclaimer below.
2. When CPs are asked to present on behalf of ETSAP, they can use the ETSAP presentation layout and logo.
3. For all other cases the CPs should consult with the ETSAP Management Team

The following disclaimer should be included in all publications/presentations which include the ETSAP logo.

Disclaimer

The views opinions, findings, and conclusions or recommendations expressed in this report are strictly those of the author(s). They do not necessarily reflect the views of any single or all Contracting Parties of ETSAP. The Contracting Parties of ETSAP take no responsibility for any errors or omissions in, or for the correctness of, the information contained in this paper, article, report, or presentation.

11. Participants

The current Contracting Parties which are participants in ETSAP are the following:

Country	IA Date of signature	Contracting Party	Participating till / from Annex:
IEA			
Australia	13.11.80	CSIRO	Current
Belgium	08.09.81	The Government	Current
Canada	07.07.82	NRCan	Until Annex XII
Denmark	04.12.80	DEA	Current
European Commission	11.01.82	European Commission	Until Annex XIV
Finland	09.01.02	TEKES	Current
France	29.01.08	ADEME/EMPT	Current
Germany	13.11.80	IER/FZJ	Current
Greece	01.12.80	CRES	Current
Ireland	01.05.09	SEAI	Current
Italy	13.11.80	ENEA/RSI	Current
Japan	17.09.81	IIEJ	Current
Kazakhstan	2015	The Government	Current
Korea	15.05.96	KEA	Current
The Netherlands	02.04.82	ECN	Current
Norway	13.11.80	IFE	Current
Russian Federation	15.09.2010	ERIRAS	XI Current
Spain	01.07.2010	The Government	Current
Sweden	18.11.80	The Government	Current
Switzerland	01.04.81	BfE/PSI	Current
Turkey	22.03.96	Kocaeli	X/
United Kingdom	09.06.81	The Government	Current
United States	13.11.80	DOE	Current
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Sponsors	2014	ENEL Foundation	Current

Invited to join / re-join ETSAP:

52 nd meeting, Brasilia, November 2007:	Turkey, China, India, Mexico, South Africa, Brazil
53 rd meeting, Paris, July 2008:	Australia, Austria, Indonesia, Kazakhstan, Portugal
55 th meeting, Venice, June 2009	Croatia
62 nd meeting, Lisbon, December 2012	China, Ukraine
65 th meeting, Beijing June 2014	Turkey, China, India, Mexico, South Africa, Brazil, Australia, Austria, Indonesia, Portugal, Croatia, Ukraine, Mexico, Czech Rep., and Singapore.
69 th meeting, Cork, May 2016	South Africa.
76 th meeting, Newcastle, May 2020	Australia New Zealand, Austria
80 th meeting, Online, December 2020	Israel
85 th meeting, Online, February 2022	Portugal
87 th meeting, Online, September 2022	Singapore