

The Electric Generation Expansion Analysis System (EGEAS) Software 2017 EPRI Update

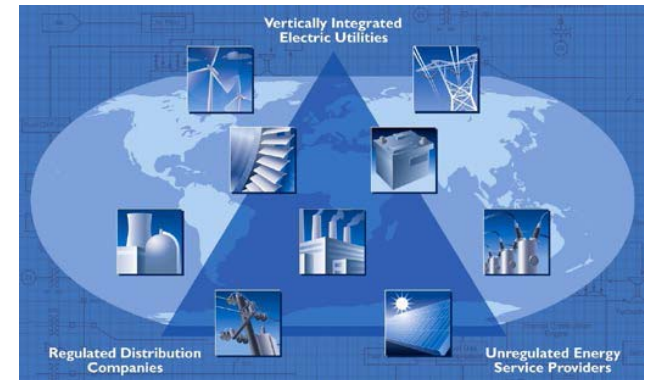
Adam Diamant
Technical Executive
Energy and Environmental Analysis

EGEAS Users Group
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Overview of EPRI's Electric Generation Expansion Analysis System (EGEAS) Software

- EGEAS is a state-of-the-art modular **production costing and generation expansion** software package.
- EGEAS is used by electric company planners and others to develop and evaluate integrated resource plans, avoided costs, plant life management plans, and environmental compliance plans.
- EGEAS accommodates **dispatchable generation** sources (e.g., coal, natural gas, nuclear, hydro), **demand-side management (DSM)** and **renewables resources** (e.g., wind, solar PV).
- EGEAS was the forerunner of the current generation of planning simulation and optimization models, and continues to be used today by a number of electric companies and regional planning organizations (e.g., MISO).
- Learn more about EGEAS here: <http://membercenter.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002008244> and here: <http://eea.epri.com/models.html#tab.=3>



Brief History of EGEAS

- 1983 — EPRI originally developed EGEAS as a research project. Key contractors included Stone & Webster Engineering Corp. and the MIT Energy Lab.
- 1990s — Stone & Webster Management Consultants Inc. developed a graphic user interface (GUI) to ease data input.
- 2013 — EPRI reactivated EGEAS v9.02.
- 2014 — EPRI released EGEAS v10, an updated and integrated version with a new GUI and improved “back end.”
- 2015 — EGEAS v11 released
- **Oct 2017 — EGEAS v12 released**
- **Q4 2018 — EGEAS v13 expected release**

EGEAS Continues to Evolve to Meet Needs of Electric Company Planners, Regulators, ISOs and Others

- Version 1 – 1983 Initial release
- Version 2 – 1985 Storage optimization, Must-run, Spinning reserve
- Version 3 – 1986 Purchase & sale contracts, Incremental costs
- Version 4 – 1989 Financial constraints
- Version 5 – 1990 Fuel constraints, Multi-area modeling
- Version 6 – 1990 Emission Constraints, System average rate
- Version 7 – 1993 Revenues, Avoided costs, Risk analysis
- Version 8 – 1996 Multi-Parameter Gamma method
- Version 9 – 1997 Bid-based pricing
- Version 9.02 – 2007 Cost and Revenues report; Ability to change measurement units; increase # of plant types and load blocks
- Version 9.02 – 2013 Reactivated by EPRI
- Version 10.0 – 2014 Integrated GUI and underlying EGEAS code; removed Finance + and RISKMIN
- Version 11.0 – 2015 Added “dump energy “ penalty factor and State RPS constraints
- Version 12.0 – 2017 (i) Added “rate-based” environmental constraints;
(ii) New output reports for generating capacities; and,
(iii) Removed numeric constraints / increased limits on variables

Important EGEAS Features

- Includes **dynamic programming** algorithm to develop candidate portfolios from identified alternatives meeting a reliability constraint (e.g., maintain 10% capacity reserve margin).
- Conducts **minimum present value revenue requirements (PVRR)**, or lowest electric rate economic ranking of candidate portfolios dispatched with an existing and future set of assets.
- Once data inputs are set-up, many **different scenarios** can be run to test different generation plans easily and quickly.
- Simple economics based on **present worth method** — easy to understand and explain results.
- EGEAS is **used by electric utilities, state regulators and various regional planning organizations**, including MISO.
- Results are easily understood, and **well accepted by regulators**.

Recent EGEAS Enhancements (v10 & v11)

- One-stop software licensing with EPRI or EPRI-licensed software “commercializers,” such as NG Planning LLC.
- Consolidated EGEAS, the Graphic User Interface (GUI), DSMLINK, and RPWorkstation programs.
- Eliminated Finance+ and Riskmin programs which are no longer supported or used
- Updated all EGEAS users guides and manuals:
 1. Capabilities Manual*
 2. Users Guide*
 3. DSMLink Manual
 4. RPW Users Guide
- Version 11 included two key new features:
 1. Dump Energy Penalty Factor
 2. Renewable Portfolio Standard (RPS) Constraint

Notes: *At MISO's request, EPRI made the Capabilities Manual and Users Guide available online for free to the public. Visit: <http://eea.epri.com/models.html#tab.=3> .

EGEAS Version 12 – Development

- MISO provided funding to develop v12, and “beta” tested v12 and provided feedback.
- NG Planning developed the v12 software code
- EPRI managed the software project and conducted software quality assurance testing for both the pre- and final production software versions.
- EGEAS v12 released October, 2017 and is available on EPRI’s website here:
 - <http://membercenter.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002008244>

EGEAS Version 12 – Key Enhancements

1. Removed existing numeric constraints and increased limits on key variables and basic plant and other quantities beyond the current numeric limit of 999 units.
2. Includes rate-based emissions constraints (e.g., lbs CO₂ / MWh).
3. New output report shows all four types of EGU generation capacities (i.e. rated, operating, emergency, and reserve capacities).
4. Updated to operate with Windows v7 (32-bit & 64-bit), v8.1, and v10.
5. Updated all four EGEAS software manuals

EGEAS Version 12 — Pricing & Licensing

- EGEAS can be licensed from EPRI or from an EPRI-licensed software “commercializer,” such as NG Planning LLC
- EPRI charges **\$35,000** for a new EGEAS v12 license
 - One-time license cost; no annual license maintenance fee
 - No limit on the number of users in a single company
 - Existing v11 licensees can upgrade for **\$5,000**
 - EPRI software commercializers may charge different fees
- Members of EPRI research program 178 & PSET-178(B) receive an EGEAS v12 license at no additional cost beyond their membership fees.
- EGEAS v12 can be ordered and downloaded here:
 - <http://membercenter.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002008244>

EGEAS v13* – Key Enhancements in Development

1. Add simultaneous rate-based and mass-based emission constraints.
2. Allow "must-run" status to be changed by segments.
3. Increase the maximum number of emission types.
4. Increase the maximum number of non-dispatchable technologies (NDTs).
5. Increase maximum NDT units for a given NDT technology.
6. Remove fatal error for excess NDT.
7. Add copying and pasting data with tables in the graphic user interface (GUI).

* EGEAS v13 is expected to be released Q4, 2018.

EGEAS End-user Support and Services is Provided by 3rd Party “Commercializers”

- EPRI licenses other entities to commercialize EGEAS and provide end-user support, including:
 - Sublicensing EGEAS to new users and existing users;
 - Providing EGEAS software training, installation, support and maintenance services; and,
 - Providing consulting services with EGEAS.
 - Any “qualified” firm can apply to be an EPRI commercializer.
- EPRI does not provide these services to end users.

EPRI Collaboration with NG Planning LLC

- EPRI has provided NG Planning with an EGEAS commercialization license
- EPRI and NG Planning have collaborated for many years on development of new enhanced versions of EGEAS
- NG Planning coordinates annual EGEAS User Group meetings
- NG Planning has helped to increase the EGEAS user base by sublicensing EGEAS to state PUCs and electric companies, and by providing training and technical support to end users.
- EPRI and NG Planning are developing EGEAS v13 to be released in 2018.

Status of EGEAS at EPRI

- EPRI members funded the original development of EGEAS in 1983 and ongoing enhancements through v10 (2014).
- In recent years, EPRI has updated EGEAS with funding provided by MISO, supplemented with internal EPRI funds:
 - Version 11 (2015)
 - Version 12 (Oct. 2017)
 - Version 13 (expected Q4 2018)
- EPRI Project Set 178B on “*Integrated Portfolio Planning and Market Analysis*” is responsible for managing EGEAS.
- EPRI remains interested in developing new versions of EGEAS, but only so long as 3rd parties pay the full cost of software development and EPRI SQA testing.

New EPRI Technology Innovation Project to Explore Potential Future EGEAS Enhancements

- Three-year project (2018-20) to explore the potential for EGEAS to be used to solve *Integrated Energy Network*[™] planning (IEN-P) challenges.
- Explore development of “end-to-end” power system resource planning tools and capabilities to do **integrated generation (G), transmission (T) and distribution (D) system planning**.
- Explore how **EGEAS may link to other key EPRI T&D system planning software tools** (e.g., DRIVE, Trans. Host Capacity Tool (THCT), and InFLEXion) and existing commercial T&D system planning tools.
- Explore how EGEAS may be modified and enhanced to incorporate and evaluate **(i) power system *reliability*, (ii) operational *flexibility*, and (iii) *resiliency*** as part of capacity expansion modeling.
- Explore how EGEAS may be used to conduct capacity expansion modeling that takes into account the **links between the electric sector and other critical infrastructure** such as natural gas and transportation.

Contact Information



Together...Shaping the Future of Electricity

Adam Diamant

Technical Executive

Energy & Environmental Analysis

510-260-9105

adiamant@epri.com