Analytics and Optimization towards Operational Excellence

District Energy Supply Optimisation

15th October 2021

By matteo.pozzi@optit.net
Spin-off of the Alma Mater Università di Bologna, we apply Operations Research, Data Science and Artificial Intelligence to design, develop and provide state-of-art Analytics and Optimization Solutions in Italy, EU & US.

Over 40 talented professionals to support Digital Innovation.

Bologna: HQ & Main Office
Cesena: Software Factory
Energy Generation (unit committment) Optimisation

**Business Objectives**

- **EBITDA Maximization**
- Increase **Asset Value**
- Optimal management of operative variables in complex CHCP systems (demand, supply, prices and constraints)

**Challenges for Decision Makers**

- Energy Demand **Forecasting**
- Multiple cost/revenues considerations
- Complex plant **configurations**
- Operative and Technical **Constraints**
- Operating and managerial reports
- High data **Intensity** (hourly planning)
A fully Engineered Solution

**INPUT DATA**

- Configuration
- Field data integration
- Weather Data
- Economic Evaluations

**KEY PROCESS MODULES**

1. **FORECASTS**
   - Demand Profile
2. **LONG TERM**
   - Budget
3. **SHORT TERM**
   - Unit Commitment
4. **INFRA-DAY & TRADING**
   - Energy Markets

**OPTIMAL PLANNING AND MONITORING**
Flexible Block based Design and Configuration of Generation Systems

**KEY FEATURES:**

- **Modular** configuration
- Extensive **Block Library**
- Each energy vector is defined by **separate flows**
- Energy flows defined by **topological constraints**
- **Multi-plant** interactions
## Advanced Demand Forecasting

<table>
<thead>
<tr>
<th>Data Cleansing</th>
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<tbody>
<tr>
<td>Outlier Removal</td>
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<tr>
<td>Missing Value Imputation</td>
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<tr>
<th>ML Models Setup / Update</th>
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<tbody>
<tr>
<td>Model Ensemble Creation</td>
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<tr>
<td>Performance Statistics</td>
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<tr>
<th>Prediction Generation</th>
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<tr>
<td>Best Model Selection</td>
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<tr>
<td>Model Combination</td>
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(raw) time series

auxiliary time series

![Data Cleansing Diagram](image-url)
Long Term Planning

LONG TERM PLANNING

- Advanced **budget** scenario functionalities
- Optimal management of **annual constraints**
- Detailed **operating plans** for each plant

**WHAT-IF**

- Production assets **redefine**
- **Sensitivity** analysis on demand & prices
- **Investment** analysis

**Elettricità (kWh)**

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<tr>
<th>fungus</th>
<th>Total</th>
<th>Jan</th>
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**Calore (kWh)**

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**Gas (Smcf)**

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**Ricavi (€)**

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**Costi (€)**

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**Margine (€)**

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Short Term Optimization

**SHORT-TERM PLANNING**

- Plant assets *operating plans*
- **Infra-day** optimization
- Small time-step *granularity* (hourly)

**PROCESS AUTOMATION**

- Field data
- Weather data
- **€** Electric prices

**PLC READY**

- Daily Schedule

**EBITDA Optimization**
Reporting & monitoring

- Flexible and extensive **reporting** capabilities
- **Alerts** and monitoring functionalities
- Data **integration** with legacy and BI systems
System Integration

**INPUT DATA**

- Meteo & forecasts
- SCADA input
- Market systems
- Parameters
- Assets availability
- Prices & bids
- External Sources

**OUTPUT DATA**

- Optimal planning
- SCADA output
- Market systems
- Monitoring & KPIs
- Alerts
- Bidding program
- Reporting
Trading Optimization: Business Integration with conflicting objectives

Energy Production & Trading Management

- **System Operators**
  - Demand Optimization
  - No additional stress on plant operations

- **District Heating Network**
  - Feasibility ensured in the bidding phase

- **Trading Operators**
  - Maximize Margins
  - Short Term Opportunities
  - Best Bidding Strategy

**Horizontal Integration**
Facilitating Business Units Collaboration

**Vertical Integration**

Cross-BU platform covering the whole supply chain

- Multi-User
- Multi-Plant
- Multi-Market
Our Approach

1. Analysis
- Plant/asset review
- IT Infrastructure
- I/O Data Req’s
- Business Goals
- Customization needs

2. Pilot Project
- Off-line Prototype
- Custom Developments
- Calibration & Testing
- Scenario Analysis
- Benefit Analysis

3. Set-Up
- Refine Customization
- System Integration
- Deploy
- System fine tuning
- Start-Up Support

4. Management
- SW and Models Maintenance
- Continuous Updates
- Support on variations

Consulting (una tantum project fee)

Una tantum + Software as a Service fee

SaaS Commercial Agreements
Benefits of Optit’s solutions

ADVANCED PLANNING SOLUTIONS DELIVER ....

**Optimization delivers proven benefits**
Advanced Planning Systems to optimize reduce operating costs and improve margins

**Increase planning speed and accuracy**
Automated forecasting and can process data faster and evaluate more options, representing a marked upgrade wrt manual planning

**Improved service quality**
Stricter management of constraints, operating policies and rules results in better overall quality of service (economic and environmental)

**Standardized Knowledge**
Optit’s solution incorporates human knowledge and company business rules to make the planning process a company standard

**Environmental impacts**
Economic optimization and operational constraints management guarantee a decreased impact on GHG and emissions KPIs

CHARACTERISTICS OF OPTIT’S SOLUTIONS

**Scalability**
Innovative interoperable solution fully web-based easily accessible from a web-browser

**In-house Optimization algorithms**
The solution is designed and developed entirely by Optit, that owns the code and methodologies. Hence specific customer implementation are easily incorporated

**Flexible business process**
The solution is easily adapted to the customer business process from a functional/operational and technological user perspective

**System Integration**
Proven capacity to interface with key company’s and external data sources, to achieve a fully integrated approach
Final remarks

- A structured **DH Digitalisation Strategy**, powered by **Advanced Analytics DSS**, is key to operate efficiently modern Energy Systems
- **Sector coupling** and energy market integration introduces new levels of complexity to DH Utilities, requiring structured Enterprise approaches enabling **new business & operating models**, yet unlocking interesting new **revenue streams** with significant impact on overall business performance
Our References in the Energy Industry (overview):

- MANUAL
- OPTIMISATION
- AUTOMATISATION
- MARKET INTEGRATION
Our positioning in the District Energy Community

INDUSTRY KNOWLEDGE AND EXPERTISE

Optit is one of the leader in the development of digital solutions and services for the district energy industry. We are actively involved in numerous innovative projects for both the development and expansion of district energy partnering with some of the world leading organizations.

Our team combines expertise from both the energy and digital industry making it the perfect match for company looking to innovate their operations.

• **Energy and Mechanical Engineers** experts in the district energy industry

• **Software Engineers** experts in the development of advanced digital solutions

• **Data Scientists** experts in data handling, data management and data driven analysis and model creations

• **OR Specialist** expert in the development of optimization models and algorithms for the energy sector

MEMBERSHIP AND ACTIVE ROLES

Matteo Pozzi (Optit’s CEO)
Vice-Chairman of EuroHeat and Power technology platform

Actively involved in the EU debate about the future of district energy and smart systems

Partner of the UN’s initiative (Belgrade project).

Sponsors and promotors for the Italian’s participation to the IEA DHC Technology Collaboration Programme

Active member involved of several national DHC associations.
### Energy Trading – high level concepts (based on the Italian market rules)

<table>
<thead>
<tr>
<th>DAY-AHEAD MARKET</th>
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<tbody>
<tr>
<td>• Hourly bids can be placed until 12:00 on the previous day</td>
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<tr>
<td>• Market price is formed (for each zone) by demand/supply intersection</td>
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<tr>
<td>• Once offers are accepted, the producer is committed to the dispatching plan</td>
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<table>
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<th>INFRA-DAY MARKETS</th>
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<tbody>
<tr>
<td>• Further bids can be placed on multiple markets at different cut-offs</td>
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<tr>
<td>• Mechanisms similar to Day Ahead</td>
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<tr>
<td>• The dispatching plan is updated throughout the day</td>
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<th>BALANCING MARKET</th>
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<tbody>
<tr>
<td>• Large Plants or Aggregated Virtual Units can offer hourly flexibility in production increase or decrease to support grid balance</td>
</tr>
<tr>
<td>• Pre-requisite is integration for direct connection to TSO calls</td>
</tr>
<tr>
<td>• Fixed + variable remuneration</td>
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<table>
<thead>
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<th>XBID MARKETS</th>
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<tbody>
<tr>
<td>• Additional market leading towards continuous trading</td>
</tr>
<tr>
<td>• Hourly bids can be placed (at given price) for future time slots</td>
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<tr>
<td>• Should kick-off before the end of 2021</td>
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Management of complex Plant Portfolio

Grouping by participation to Balancing Markets

Grouping by participation to Infra-day Markets

Characterization of each plant in the portfolio

Complex plant portfolios and engagement with different electricity markets (with a view to XBID) must be managed
MSD (Dispatchment Services Market)

- Management of capacity reserved for TSO flexibility needs
- Heavily regulated process
Advanced Trading Management

- Monitoring of assets availability
- Dynamic marginal costs calculation for each production asset in the portfolio
- Sophisticated calculation of convenient production portfolio at given price
- Workflow with multiple decision cut-offs (Day-ahead, Infra-day sessions, XBID)
- Possibility to customise specific Trading Strategy