Total Energy Management for Production Operations

Project funded by Enterprise Ireland under the Technology Centre Programme.
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Principal Investigator – Total Energy Management for Production Operations (TEMPO).

- Three Year Industry Driven Project.

- Collaboration between Limerick Institute of Technology and University of Ulster.

- Largest National Funded Project on Energy Efficiency (Funded through Enterprise Ireland)

- Core Team of 6 Researchers Managed by Dr. Frances Hardiman.

- Collaboration of 20 Researchers, Staff and Postgrads.

- Excellent Support from Industry Stakeholders, Intel, DePuy, GSK, Analog Devices, Vistakon, EMC and Carberry.
Energy Efficiency in Industry

Key Principles
Turn Things OFF or Turn Them DOWN

1. Understand **Where and How** your operation consumes energy
2. Understand **When** your operation consumes energy
3. Purchase Energy at the best available rate matching your consumption profile
4. Turn **OFF** Significant Energy Users (SEUs) when not needed – Engage Employees
5. Supply the correct amount of Technical Services required as production varies
6. Over time replace equipment/machines with more efficient ones
7. Provide Energy Inputs into new product/process design
8. Install waste heat recovery / alternative energy
Industry Problem Statement

- Energy Management Systems are not optimised to effectively monitor energy consumption in production operations.
Overview

TEMPO is a Proof-of-Concept Research Project Based on

Matching the Consumption to the Activity

TEMPO is a LENS

- Can focus on a specific Asset
- Can focus on a Production Line
- Can focus on an Energy Carrier
- Can focus on a Technical Service

Grounded on Principles of LEAN Manufacturing
- Product Centred View / Value Stream Mapping
Client Input Tool, Value Stream Based analysis of production and energy flows that highlights existing data and potential for virtual, inferred and simulated metering

Smart Energy Network, Drivers/adapters for integrating with standard industrial systems, existing database systems and with a Low Cost Energy Monitoring Network

Energy Modeling Tool with Mass Balance calculation, Machine profiling, waste energy analysis, Tariff and time of use analysis, decision support, economics and carbon analysis.

Energy Flows and Metrics Visualisation, selectable to drill down from Factory to process step and to present data for Management and for Shopfloor engagement. Energy Forecasting.
Industry Need

- Develop a Monitoring & Targeting (M&T) Strategy with as little sub-metering as possible
- Allocate the actual cost of energy consumption to the value streams.
- Develop suitable KPIs and Visualisations to manage the energy consumption.
- Continuously leverage production personnel to drive cost reduction and energy improvements

Case Study #1

Focus on Energy Tracking Solution for Production Line (Sigma) with limited metering.

1. Auxiliary Energy (waste) identified via production schedules
2. TEMPO Database (on-site) linking Production Information (OMS) with Value Stream Electricity Consumption (E-Sight)
3. Inico Dataloggers on key SEUs for Profile Building

Results:
Value Stream Model based on Machine Power Profiles linked to Production Data.
Energy Prediction >90% accurate without any metering

CASE STUDY # 1
Total electrical Consumption 22 GWh
Case Study #1

VS Process Mapping

Results:
Clear Identification of Process SEUs.
Case Study #1

Clearly quantified Auxiliary (Waste) Energy at WeekEnds

- Now Quantified at Value Stream Level in Real Time.
- Reduced Design Costs

Results:
“Last Uncontrolled Cost” Visibility for Production Manager on Actual Energy Costs.
Industry Need

- Develop a modelling tool to assess the ongoing performance of Technical Services (HVAC, Process Chillers, Water, Nitrogen, Compressed Air)
- Link the performance of the Technical Services to the Production Activity
- Provide decision support (Scenario Analysis) for various what-if scenarios

Case Study #2 Pilot running in Cork. Dec–March 2015.
Case Study #2 Continuous Production Line

Focus on aligning the operation of the technical services with production.

- Process Chiller
- HVAC

- Profile monitoring of flow and temp through Inico Logger
- Inferred VSD Data from DeltaV
- Dynamic performance linked with real time production data

Results:
Process Chiller Model developed – COP Validated

Case Study #2
Total energy Consumption
> 60 GWh
Case Study #2 – HVAC

Scenario One:
Splitting the steam process
- **Potential energy savings:** 17%

Scenario Two:
Changing Fans to VSD with Operating load @ 70%
- **Potential energy savings:** 29%

Scenario Three:
Shutting down the critical loop when production doesn’t need it.
Plus changing to VSD.
**Total energy savings:** 60%!

**Results:**
Quantified Opportunity for savings identified.
Costing of solutions now needed.
Industry Need

- Energy Consumption is a small portion of running costs and there are limited internal resources to focus on Energy.

- However, being able to predict the specific Energy cost of different production operations would increase competitiveness.

CASE Study #3 Pilots running in Limerick with two Precision Engineering SMEs. (March – May 2015)
Case Study #3

TEMPO as a Service

Incoming Mains 23rd December 2014-6th January 2015

Base Load through Christmas Shut-down, 30% of Normal Consumption
Waste of €1,000 over 10 days

TEMPO can Identify
Where is the waste?

Process Mapping indentified the SEUs
Data-Logging and Profile Analysis linked to Production Data gives the cost of Energy/Run Cost

Cincinnati Lathe 16th Dec-17th (1 minute interval)
Industry Need

➢ To raise energy awareness across the company, to provide technical training to energy specialists and to instil an energy culture in the production workforce.

Pilot planned in a discrete Manufacturing Facility.
(May – June 2015)
**On-Site Energy Clinic**
Employees able to book 15 min slots with the ‘Energy Doctor’.
Identified pro-active employees with an interest in Energy.
Identified Energy Champions for different functional areas.

**Value Stream Micro-Training**
As an Output of the TEMPO Mapping Process.
Development of Visual Aids and short on-site training workshops to influence behaviour of employees and to capture shop-floor inputs to Energy Management.

**Module in Energy Efficiency in Industry**
Night Class - Available in LIT Moylish and LIT Clonmel in September.
Available as a in-house Delivery
On-line Distance Learning delivery in development.
Challenges

Development Pains
Interaction between Corporate and Factory IT Systems
Engineering Overhead for Data Gathering and Model Building
Engagement of Operators needs to be relevant to Production Line
We need to develop a simplified Tool (TEMPO Lite) for energy audits, tariff analysis and automated reports

The ASK

For the next stage of development of TEMPO we are looking for further Manufacturing and Industrial Sites for Partnerships – co-funded through National and European Programmes.

We are also looking to partner with an Energy Service / Management Company in the development of TEMPO as a commercial product.
TEMPO Provides a dynamic view of Industrial Energy Consumption which is necessary for the development of:

- Smart Heat Networks
- Smart Electrical Networks
Smart Heat Networks

SYNSeR: SYNERGY SUPPORT SERVICE DEVELOPMENT FOR INDUSTRIAL ECOLOGY

LEDPS Feasibility Study
TEMPO can link Factories to the Smart Grid in order to reduce the cost of Electricity based on dynamic pricing and active demand response.

SENPRO Smart Electrical Network for Production Operations

H2020 Proposal
LIT Discovergy ESB Innovation + Manufacturing Site.

Electricity Consumption in Production can be predicted with 90% Accuracy. [3+1].

Result: Case Study
Savings of 4% in Cost of Electricity based on applying Northern Ireland Tariff Structure.
Key Value Propositions

TEMPO Methodology & Software

- Identifies Significant Energy Users (SEUs) in Production and quantifies opportunities for cost reduction
- Drives reductions in energy consumption through Value Stream (VS) process improvements
- Reduces the cost of metering through use of existing data, systems and models
- Avoids the cost of future increases in energy consumption through ongoing energy management and energy KPIs (EnPis)
- Provides accurate energy costing for production runs
- Validates the savings of energy efficiency projects and verifies the relevant carbon savings.
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