EUROPEAN COMMISSION
RTD - Energy
ENER - Renewables, R&I, Energy Efficiency
JRC – Institute for Energy and Transport
SET Plan Secretariat

SET-Plan ACTION n°6 - Declaration of Intent

"Continue efforts to make EU industry less energy intensive and more competitive"

1. Purpose of this document

This document[1] is intended to record the agreement reached between representatives of the European Commission services, representatives of the EU Member States, Iceland, Norway, Turkey and Switzerland, and representatives from the SET-Plan stakeholders most directly involved in industry, on the implementation of the actions contained in the SET-Plan Communication[2], and specifically the strategic Research & Innovation (R&I) targets for the priority "Number 6 – Continue efforts to make EU industry less energy intensive and more competitive ".

This agreement follows consultations with:

- BUSINESSEUROPE (European National Business Federations) [3]
- CEFIC (European Chemical Industry Council)
- CEMEP (European Committee of Manufacturers of Electrical Machines and Power Electronics)
- COGEN Europe (European Association for the Promotion of Cogeneration)
- CONCAWE (European Petroleum Refiners Association)[4]
- EEIP (Energy Efficiency in Industrial Processes)
- EERA (European Energy Research Alliance)
- EUA – European University Association
- Eurofer (European Confederation of Iron and Steel Industries)
- Euroheat & Power (District Heating & Cooling and Combined Heat & Power Association)
- Orgalime (Mechanical, Electrical & Electronic, Metalworking & Metal articles industries) [5]
- SPIRE (Sustainable Process Industry through Resource and Energy Efficiency)

on an issues paper prepared by the Commission services, which was published on the SETIS website[6]. It takes into consideration eleven responding input papers (incl. CEMBUREAU, EPPSA, EU-Turbine-ETN) available on SETIS and discussions in the SET-Plan Action 6 Stakeholders meeting on 17 February 2016 with the participation of the SET-Plan stakeholders most directly involved in the topic.

The public and private stakeholders agree to highly ambitious R&I targets in an endeavor to improve EU industry energy efficiency and competitiveness, to collaborate in a coordinated way between public and private sectors, and to jointly address all relevant issues in order to attain the agreed R&I targets.

Research & Innovation in energy efficiency can contribute to a more sustainable and competitive European industry, however this option should be considered alongside other innovations for resource efficiency, the utilization of alternative feedstock, and renewable energy.

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1 This document has no legally binding character, and does not prejudge the process or final form of any future decisions by the European Commission.
2 Towards an Integrated Strategic Energy Technology (SET) Plan (C(2015)6317).
3 Businesseurope has been consulted but is not part of the agreement
4 Concawe has been consulted but is not part of the agreement
5 Orgalime has been consulted but is not part of the agreement
6 Strategic Energy Technology Information System website https://setis.ec.europa.eu/towards-an-integrated-SET-Plan

2. Drivers and means to improve EE in industry

In 2013, the industrial sector accounted for 25.1% of the total final energy consumption in the EU-28[7]. Energy in industry is mostly used for process heating and cooling, which represents about 63% of the total industry final energy demand.
R&I in industrial energy efficiency is needed to ensure industry contributes to climate change targets and further increase their export competitiveness in a situation where manufacturing companies from across the globe have more and more access to the same energy saving technologies. R&I investments is therefore necessary to further improve our technological leadership and innovation know-how.

Technologies can be grouped into sector specific technologies and cross-cutting technologies.[8]

- Sectoral technologies are tied to specific materials or processes of a given sector.
- Cross-cutting technologies can be applied across many sectors.

- Beyond technologies, innovations related to industry organisation, management, employees' behavioural change are also important ways of increasing energy efficiency of production. However, this paper focuses on the technological aspects related to energy efficiency in industry and therefore it does not address these other important drivers. Other issues of socio-economic, regulatory or other nature that may be of relevance in achieving the targets will be addressed at a later stage.

3. How R&I on sector-specific technologies can contribute to higher efficiency in industry?

To maximise impact of R&I, there is a need to prioritise sector-specific technologies with the highest potential. For that purpose, eight industrial sector groups have been analysed which account for 98% of the industrial final energy consumption in EU28.

Sector metrics – only for the purpose of prioritising (sources: [9] [10])	Final energy consumption	Economic[11] potential savings by 2030 (payback <=2 year)	Technical[12] potential savings by 2030	Energy[13] cost/ Value Added	No. of employed	Value added, gross
Sector	Mtoe/y	Mtoe/y	Mtoe/y		Million	€ billion
Pulp and paper	34.3	1.1	7.2	16%	1.43	79.0
Iron and steel	50.8	2.9	16.3	36%	0.63	39.7
Non-metallic mineral	34.2	1.2	7.1	23%	1.29	63.9
Chemical and pharma.	51.5	2.6	16.5	12%	1.72	229.8
Non-ferrous metal	9.4	0.5	1.9	23%	0.46	23.7
Petroleum refineries	44.7	1.7	10.6	44%	0.12	24.3
Food and beverage	28.4	1.4	6.8	10%	4.53	251.4
Machinery	19.3	1.0	5.3	3%	9.03	579.8
Total	**272.5**	**12.4**	**71.7**			

[7] Source: Eurostat, June 2015,
[8] ICF 2015a "Study on energy efficiency and energy saving potential in industry and on possible policy mechanisms", 1 December 2015, https://ec.europa.eu/energy/sites/ener/files/documents/151201%20DG%20ENER%20Industrial%20EE%20study%20-%20final%20report_clean_stc.pdf
[9] Final energy consumption, EE potential, Energy intensity: ICF 2015a, based on Eurostat 2013 data for EU28
[10] No of employed (2012), Value added (2013): Eurostat
[11] Energy saving potential considering a deployment by 2030 of the technologies that are today already existing and economically viable with a payback not longer than 2 years. (source: ICF2015a, not endorsed by industry) .
[12] Sum of energy saving potentials of all technically feasible technologies, regardless of economic or mutual compatibility constraints (source: ICF2015a, not endorsed by industry)
[13] Energy cost intensity, i.e. the proportion of the energy cost in the value added of the product

Iron & Steel, Chemical & Pharmaceutical and Petroleum & refineries account for 54% of the final energy consumption and 61% of the technical saving potential. For Iron & Steel and Petroleum & refineries, the cost of energy is a high share of the value added and therefore significantly affects their competitiveness. The sectors with the highest employment and value added are Chemical & Pharmaceutical, Food & Beverage and Machinery, but the last two sectors are not energy intensive.

Based on these criteria, it was proposed to focus the EU's sector-specific R&I efforts on cooperating on three sectors, which have the greatest potential for energy savings and enhanced competitiveness: Iron & Steel, Chemicals & Pharmaceuticals and Petroleum refineries. However, after consultation of the relevant stakeholders, it appeared that the Petroleum Refineries sector would mostly benefit from the cross-cutting technologies and that R&I on sector specific technologies for Petroleum Refineries should not be prioritised at this stage. Therefore, it was decided to focus on two sectors: Iron & Steel and Chemicals & Pharmaceuticals.

The aim of the prioritisation is to be more focussed and so identify and implement concrete and coordinated actions. Activities in other sectors are not excluded and, if a number of stakeholders and/or Member States want to cooperate on specific actions, they are invited to make proposals for concrete actions. The other sectors will also benefit from actions addressing the cross-cutting technologies.

For the two identified sectors, we have classified their sector specific technologies according to their maturity and economic viability:

a) the existing technologies which have been demonstrated but are not (yet) economically viable, i.e. with payback period longer than 3 years[14]
b) the emerging technologies, which still need to be validated in pilot or demonstration plants

Priorities[15] 1 and 2	**R&I Targets**	**Indicators**
1. Sector specific R&I: Increasing the energy efficiency of our most energy consuming industries by **increasing the cost effectiveness of not yet economically viable technologies** (TRL>=7) through technological development, while striving to reduce GHG emissions proportionally	By 2030, at least 1/3 [16] of the technical potential energy savings related to sector-specific technologies, identified for Iron & Steel and Chemical & Pharmaceutical, become economically viable (Payback <= 3 years)	Progress of the cost effectiveness of the identified technologies; cumulated energy saving potential of technologies reaching economic viability. Two sets of Assumptions: • Fixed energy prices & production volume • Actual energy prices & production volume
2. Sector specific R&I: Increasing the energy efficiency of our most energy consuming industries by **progressing emerging technologies** (TRL 4 to 6), while striving to reduce GHG emissions proportionally	By 2030, 1/3 of the currently promising emerging technologies are successfully demonstrated at large scale (TRL>=8)	R&I Maturity progress (lab, pilot, large scale demonstration)

[14] Stakeholders agreed a payback of 3years (not 2) is more realistic (vs energy prices) and still a reasonable economic threshold
[15] There is no ranking among the five priorities. They are numbered for easy reference.
[16] The quantification of the targets for Iron & Steel and Chemical & Pharmaceutical are detailed in Annexes 1 & 2

4. How R&I on crosscutting technologies can contribute to higher efficiency in industry?

Due to their applicability to all sectors, there is a large energy savings potential in cross-cutting technologies.

Priorities 3 to 5	R&I Targets (baseline 2015)	Indicators
3.Cross-cutting R&I: maximising the **recovery of industrial excess heat/cold** in a cost efficient manner	By 2025, develop and demonstrate (to TRL 8) cost effective excess heat/cold recovery solutions (e.g. heat exchangers, upgrade to higher temperature, storage, distribution, heat-to-power, heat-to-cold, power-to-heat)	Evolution of solutions maturity (TRL), of their cost effectiveness and energy efficiency performance with reference to Best Available Techniques (BAT) (Industrial Emissions Directive)
4. Cross-cutting R&I: maximising the energy efficiency of cross-sector **industrial components** in a cost efficient manner	By 2025, develop and demonstrate (to TRL 8) industrial components whose losses are reduced by 15% (e.g. boilers, dryers, pumps, compressors, fans, conveyors … all of which systems typically contain motors and drives)	Evolution of solutions maturity (TRL), of their cost effectiveness and energy efficiency performance with reference to BAT / Progress of minimum energy performance standards
5.Cross-cutting R&I: Improving **system integration, optimal design, intelligent and flexible operation, including industrial symbiosis,** to increase energy and resource efficiency while striving to reduce GHG emissions	By 2025, develop and demonstrate solutions enabling small and large, industries to reduce their energy consumption by 20% while striving to reduce GHG emissions proportionally	% of specific energy savings (J/unit of product or J/goods produced in industrial park) achieved by at least 10 projects in at least 5 industrial sectors

All sectors will benefit from highly efficient **industrial components**, in particular the Food & Beverage and Machinery sectors. The components optimisation shall be embedded in the overall system optimisation at design stage, addressed in Priority 5.

Optimal design, intelligent and flexible operation include static modelling for process integration and energy efficiency optimisation at design stage, but also dynamic modelling to allow real-time process control and optimisation, based on system monitoring and sub-metering. By means of flexible production and electrical as well as thermal demand response, the industry could play a role in balancing and reacting on fluctuating supply of renewables. Increasing fuel flexibility will facilitate the use of sustainable energy sources in Industry. At the same time, industry will make sustainable production more economically viable and reduce its carbon footprint.

Heat and cold recovery technologies are instrumental for intra-plant optimisation and inter-plant integration to enable cascade use of heat (or cold) between cross-sectoral plants in industrial parks, and with district heating/cooling networks. A mapping of the industrial excess/surplus heat and cold while considering the proximity to users such as other industrial sites, district heating and cooling networks in EU would contribute to better prioritise R&I programme.

This **system integration** covers not only energy/heat/cold flows but also materials and by-products reuse across sectors (e.g. CO2, CO, H2), thereby contributing to industrial symbiosis and circular economy.

Enterprises in all sectors and all sizes (small, medium and large) will benefit from priorities 3 to 5. Special attention shall be paid to small size applications to ensure wide take up by SMEs.

5. Next Steps

The public and private stakeholders will:

- develop within 6 months a detailed implementation plan for the delivery of these R&I targets, in particular:
    - determine joint and/or coordinated actions; to identify the ways in which the EU and national research and innovation programs could most usefully contribute;
    - identify the contributions of the private sector, research organizations, and universities;
- identify all issues of a technological, socio-economic, regulatory or other nature that may be of relevance in achieving the targets;
- report regularly on the progress with the purpose to monitor the realisation of the targets and take rectifying action where and whenever necessary.

Annex 1*: Preliminary* list of technologies for the Iron & Steel sector

Existing but not yet economically viable technologies (Priority 1)

1. Integrated control system
2. Basic Oxygen Furnace Waste Heat and Gas Recovery
3. Exhaust gas heat recovery (furnace)
4. Combustion optimization (furnace)
5. Scrap Pre-Heating
6. Sinter Plant energy saving and Waste Heat Recovery
7. Stove Waste Gas Heat Recovery

The energy saving and recovery technologies of the EU steel sector were reviewed in the ESTEP[17] report on '*energy efficiency of the steel production*', summarising the results of an investigation (from 2010 to 2013) as a contribution to the SET Plan actions. Considering the reported technical energy potential of about 10% and taking into consideration the reported energy consumption of 20 GJ/t hot rolled products for the integrated steel plants and 9.5 GJ/t hot rolled product for the electric steel plants as well as a production share of 60% via the integrated steel plants and 40% via the electric steel plants, one finds a weighted average energy consumption of 15.8 GJ/t hot rolled products and a technical energy potential of 1.58 GJ/t hot rolled products. Considering a production of about 160 Mio tonne per year leads to a technical energy potential of 268.6 Mio GJ per year, which corresponds to an energy saving technical potential of about 6.4 Mtoe per year.
Assuming at least 1/3 of the sector-specific, not yet economically viable technologies (TRL>=7), could become economically viable through technology development, the potential energy saving would be equivalent to at least 2.1 Mtoe/a

Emerging technologies (Priority 2)

8. Top Gas Recycling Blast Furnace
9. Smelting Reduction – ULCOS-Hisarna
10. Direct reduction - ULCORED
11. Electrolysis - ULCOWIN

[17] ESTEP Steel production - EEWG Final report, January 2014 http://cordis.europa.eu/pub/estep/docs/wg7-final-report.pdf

Annex 2*: Preliminary* list of technologies for the Chemical & Pharmaceutical sector

Existing but not yet economically viable technologies (Priority 1)

1. Improved process by catalysts (ICF: 1627 ktoe)
2. Optimisation of distillation column operation (ICF: 339 ktoe)
3. Novel separation processes (including membranes) (ICF: 122 ktoe)
4. Improved exhaust gas treatment for further valorisation (TBD)
5. Low temperature heat recovery (ICF: 1946 ktoe)

Due to the diversity of processes and products in the Chemical and Pharmaceutical industry, it was not possible to assess the energy saving potential of the technologies within the deadline. Therefore, the estimations of the ICF 2015 study have been used for this preliminary assessment. This assessment shall be part of the development of the implementation plan.

The energy saving potential of these technologies could be equivalent to 4Mtoe/a. Assuming at least 1/3 of the sector-specific, not yet economically viable technologies (TRL>=7), could become economically viable through technology development, the potential energy saving would be equivalent to at least 1.3 Mtoe/a, according to the ICF study; these figures are not confirmed by the industry.

Emerging technologies (Priority 2)

6. Improved reactor design
7. Process optimisation and improved process design
8. Emerging separation technologies (including membranes)
9. New materials to minimize corrosion and fouling
10. Integrated control system

Note: some of these technologies can also be used in other sectors