



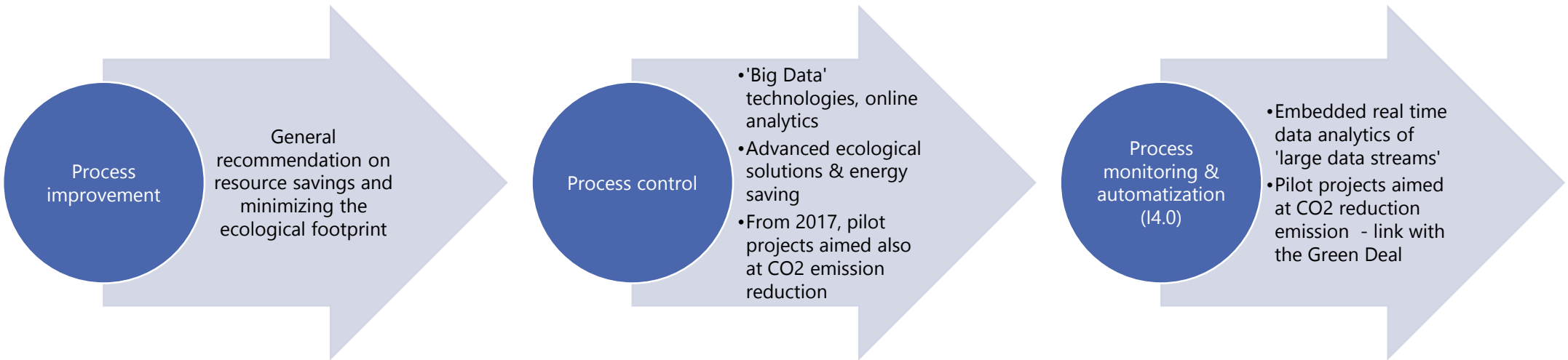
Roadmap for future research targets about cracks in continuous casting

European webinar and round table with the stakeholders of the EU steel industry

Roadmap and research needs in RFCS



RFCS Priorities storyline



Priorities – storyline (1)

2013 STEEL PRIORITIES

- 2.1 Improved energy efficiency compared to present technologies in high temperature processes by recovery of waste heat.
- 2.2 Integration of process monitoring, control and technical management for a multi-criteria optimisation of steel production with respect to at least two of the following aspects: productivity, resource efficiency and product quality.
- 2.3 New or improved resource efficient processes to transform low quality or "secondary" raw materials (e.g. slag, dust, scale, sludge, low quality scrap) into valuable products.
- 2.4 Solutions directly aiming at minimizing the ecological footprint of the Steel Works with respect to one of the following issues: air, water, soil, biodiversity and CO2 emissions.
- 2.5 Measurement and on-line control of mechanical properties, through either new measurement techniques or improved physical models.
- 2.6 Development of new steel grades with improved technological property combinations (e.g. strength, formability, toughness...) enabling more efficient steel applications (e.g. weight reduction, energy absorption, thermal shock resistance, wear...).
- 2.7 Development of steel solutions for transport, construction or energy (including renewables) applications with improved life cycle assessment (LCA) results.
- 2.8 Safety of steel infrastructures (e.g. pipes, pipelines, vessels, fittings) for cost-efficient fluid storage and transportation in the energy sector.
- 2.9 Improvement of working conditions through innovative solutions by use of both modelling and monitoring activities directly associated to risks prevention or safety.

2014 STEEL PRIORITIES

- 2.1 Improved energy efficiency in high temperature processes by recovery of waste heat without drawback on environmental impact compared to present best available technologies
- 2.2 Integration of process monitoring (online/offline) AND control AND technical management of steel production using mathematical methods for a multi-criteria optimisation of steel production with respect to at least two of the following aspects: productivity, resource efficiency, product quality
- 2.3 New OR improved resource efficient processes to transform low quality primary raw materials OR secondary raw materials (e.g. slag, dust, scale, sludge, low quality scrap) into valuable products
- 2.4 Solutions directly aiming at minimizing the ecological footprint of the Steel Works with respect to one of the following issues: air, water, soil, biodiversity, CO2 emissions
- 2.5 Measurement AND on-line control of mechanical properties, through either new measurement techniques OR improved physical models
- 2.6 Development of new steel grades with improved technological property combinations (e.g. strength, formability, toughness, etc.) enabling more efficient steel applications (e.g. weight reduction, energy absorption, thermal shock resistance, wear, ...)
- 2.7 Development of steel solutions for transport OR sustainable construction (focusing on energy efficiency AND carbon neutralisation) OR energy applications (including renewables) with improved life cycle assessment (LCA) results
- 2.8 Safety of steel infrastructures (e.g. tubes, pipes, pipelines, vessels, fittings, structural elements) for cost-efficient fluid storage AND transportation in the energy sector
- 2.9 Improvement of working conditions in steel production through innovative solutions by use of both modelling AND monitoring activities linked to health OR safety aspects risk management

2015 STEEL PRIORITIES

- 2.1 Improved energy efficiency in high temperature processes by recovery of waste heat without drawback on environmental impact compared to present best available technologies
- 2.2 Integration of process monitoring (online/offline) AND control AND technical management of steel production using mathematical methods for a multi-criteria optimisation of steel production with respect to at least two of the following aspects: productivity, resource efficiency, product quality
- 2.3 New OR improved resource efficient processes to transform low quality primary raw materials OR secondary raw materials (e.g. slag, dust, scale, sludge, low quality scrap) into valuable products
- 2.4 Solutions directly aiming at minimizing the ecological footprint of the Steel Works with respect to one of the following issues: air, water, soil, biodiversity, CO2 emissions
- 2.5 Measurement AND on-line control of mechanical properties, through either new measurement techniques OR improved physical models
- 2.6 Development of new steel grades with improved technological property combinations (e.g. strength, formability, toughness, etc.) enabling more efficient steel applications (e.g. weight reduction, energy absorption, thermal shock resistance, wear ...)
- 2.7 Development of steel solutions for transport OR sustainable construction (focusing on energy efficiency AND carbon neutralisation) OR energy applications (including renewables) with improved life cycle assessment (LCA) results
- 2.8 Safety of steel infrastructures (e.g. tubes, pipes, pipelines, vessels, fittings, structural elements) for cost-efficient fluid storage AND transportation in the energy sector
- 2.9 Improvement of working conditions in steel production through innovative solutions by use of both modelling AND monitoring activities linked to health OR safety aspects risk management



Priorities – storyline (2)

2016 STEEL PRIORITIES

- 2.1 Online analytics of large data streams coming from various sources (using Big Data technologies) to improve plant/process reliability or to realise machine supported decisions on product quality or to improve the flexibility of production scheduling
- 2.2 Improvement of workers' potential by use of advanced tools (including management of knowledge) to improve working conditions, safety, training, knowledge preservation
- 2.3 Advanced industrial ecology (IE) solutions in iron and steelmaking processes for integrating technologies which enhance the use of the by-products (internal and external available) or of the discharged water or of the off-gases as resources
- 2.4 Development and improvement of hybrid solutions for new and existing constructions in view of structural performance and improving the overall building performance
- 2.5 Cost effective lightweight steel solutions for new vehicle concepts or components with improved LCA or safety performance
- 2.6 Adapting processing from upstream to downstream steps to overcome the challenges raised by innovative steel grades (enhanced functional or smart properties) by novel or improved process or control techniques
- 2.7 Energy efficiency in high temperature steel processes: To develop processes and technologies allowing to capture and utilise waste process heat for production purposes
- 2.8 Developing of steel solutions suitable for advanced, low CO₂, fossil and/or renewable fuels fired power plants
- 2.9 New or improved steel process technologies to improve production flexibility and/or to allow use of lower-quality primary or secondary raw materials

2017 STEEL PRIORITIES

- 2.1 Online analytics of large data streams coming from various sources (using Big Data technologies) to improve plant/process reliability OR to realise machine supported decisions on product quality OR to improve the flexibility of production scheduling;
- 2.2 Improvement of workers' potential by use of advanced tools (including management of knowledge) to improve working conditions, safety, training, knowledge preservation;
- 2.3 Improvement in resource OR energy efficiency in iron OR steelmaking processes, by use of by-products/residuals or waste heat;
- 2.4 Pilot projects validation of emerging AND innovating technologies leading to efficiency improvements AND CO₂ emission reduction;
- 2.5 Cost effective lightweight steel solutions for new vehicle concepts or components with improved LCA or safety performance;
- 2.6 Adapting processing from upstream to downstream steps to overcome the challenges raised by innovative steel grades (enhanced functional or smart properties) by novel OR improved process OR control techniques.

Steel Annual Priorities 2018

- Steel Priority 1:** Embedded real-time analytics of large data streams to predict reliability of steel production plants and processes or to realise machine supported decisions on steel product quality along the production chain or to improve flexibility of production scheduling including human sustainable ergonomic aspects.
- Steel Priority 2:** Improvement in resource or energy efficiency in iron or steelmaking processes, by use of by-products/residuals or waste heat
- Steel Priority 3:** Pilot/demonstration projects or Accompanying Measures of emerging and innovating technologies leading to energy efficiency improvements and CO₂ emission reduction

Steel Annual Priority 2019

- Priority 1 :** Pilot/Demonstration projects or Accompanying Measures of emerging and innovating technologies leading to industrial efficiency improvements and/or emission reductions.

Steel Annual Priority 2020

- Priority:** Pilot/demonstration projects of emerging and innovative technologies leading to emission reductions and industrial efficiency improvements. This will include the concept of zero-carbon steel making process in line with the spirit of the European Green Deal Communication.

Priorities : needs and trends

Recommended key research topics to address future challenges

- climate change (***emission reduction***),
- resource efficiency,
- rational use of energy,
- new high-performance steels,
- steel and steel-based solutions for safe and improved applications,
- Industry 4.0 and digitalization,
- cost effectiveness,
- adaptation of working conditions, and
- workforce skills.



European Commission
 Directorate-General for Research and Innovation
 Directorate D — Clean Planet
 Unit D.3 — Low Emission Future Industries Contact
 Email herve.martin@ec.europa.eu
RTD-PUBLICATIONS@ec.europa.eu

https://ec.europa.eu/info/publications/research-fund-coal-and-steel-monitoring-and-assessment-report_en

Priorities – storyline (2)

Within the most pertinent lines for the RFCS research programme arising from the European Green Deal Communication, applicants to RFCS-2020 call should consider the following elements when preparing their proposals:

- Energy-intensive industries, such as steel [...] are indispensable to Europe's economy, as they supply several key value chains. The **decarbonisation and modernisation of this sector is essential.**
- The Commission will support clean steel breakthrough technologies leading to a zero-carbon steel making process by 2030.
- A power sector must be developed that is based largely on renewable sources, complemented by the **rapid phasing out of coal**
- The EU should also reinforce current initiatives [...] on cross-cutting climate and environment issues. This may include ending global fossil fuel subsidies in line with G20 commitments, [...] phasing out all new coal plant construction, and action to reduce methane emissions
- Focus on the regions and sectors that are most affected by the transition because they depend on fossil fuels or carbon-intensive processes
- Protect the citizens and workers most vulnerable to the transition, providing access to re-skilling programmes, jobs in new economic sectors

Steel Annual Priority 2020

Priority: Pilot/demonstration projects of emerging and innovative technologies leading to emission reductions and industrial efficiency improvements. This will include the concept of zero-carbon steel making process in line with the spirit of the European Green Deal Communication.



Priorities – storyline (2)

Steel Annual Priority 2020

Priority: Pilot/demonstration projects of emerging and innovative technologies leading to emission reductions and industrial efficiency improvements. This will include the concept of zero-carbon steel making process in line with the spirit of the European Green Deal Communication.

The objective of the 'emerging and innovative' technologies is to support either significant additions to or changes of the current steel production processes, or to develop breakthrough and game-changing technologies with the aims of sensible industrial efficiency improvements regarding energy efficiency, product quality, production yield, emission/carbon footprint reduction or all kinds of environmental issues.

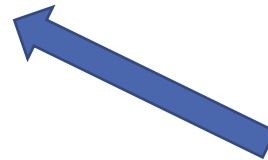
Projects should address one or more of the areas below which could meet the criteria of 'emerging and innovative technologies':

- Breakthrough steel production that allow a significant or complete switch from fossil carbon to alternative reducing agents such as clean hydrogen or electricity.
- Alternative steel production processes that make use of fossil fuel in a way that facilitates integrated CO₂ capture.
- CO₂-Usage and Valorisation: utilising either the CO₂ captured in steel plants or directly the CO/CO₂ content of the steel plant gases as raw material for production of valuable products.
- Process additions or modifications that are designed to be integrated in conventional steel plants with the objective to significantly reduce CO₂ production or to capture CO₂ in line with the production processes, at low energetic cost for e.g. switch to leaner carbon/energy sources in existing processes: replacing fossil coals by leaner carbon/energy sources such as natural gas, biomass or C-lean electricity.

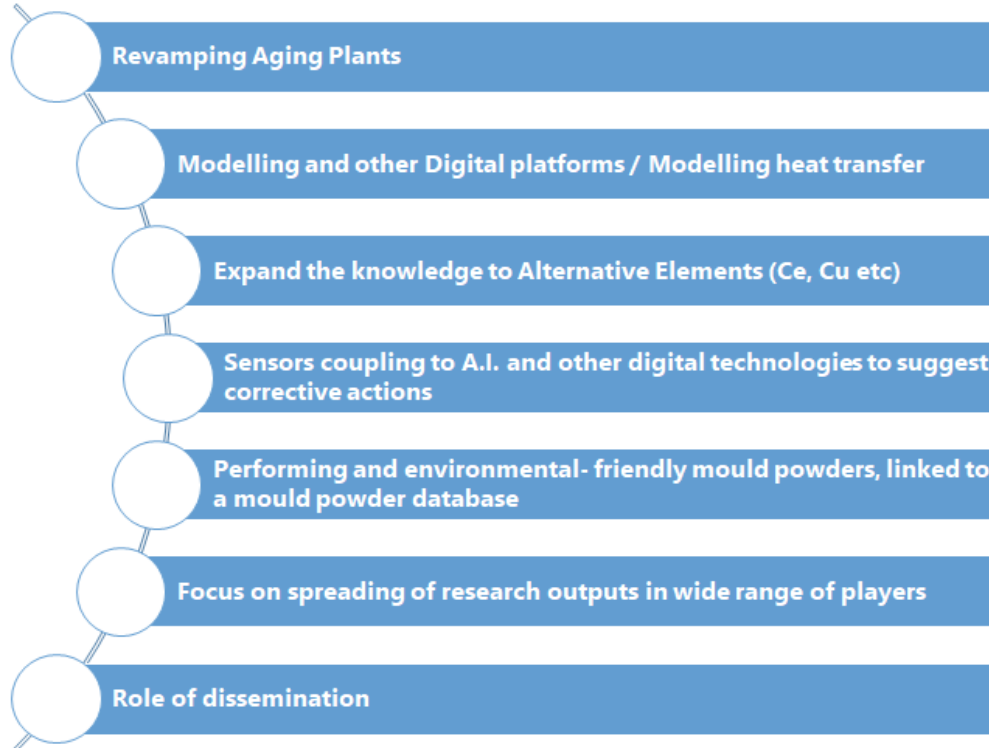
Steel Annual Priority 2020

Priority: Pilot/demonstration projects of emerging and innovative technologies leading to emission reductions and industrial efficiency improvements. This will include the concept of zero-carbon steel making process in line with the spirit of the European Green Deal Communication.

- Significant improvements of energy efficiency of the complete steel production route by using waste heat (from gas, gas flares, fumes, water, solids; at low or high temperature), better use of steel plant gases or any other way to reduce energy consumption, e.g. smart integration of renewable energies in steel plants (e.g. solar, wind, geothermal, clean hydrogen), depending on the local potential, to cover some of its electricity and/or heat demand.
- Sustainable, efficient valorisation of residues and end-of-life materials for a conversion into valuable secondary raw materials for an enhanced material cycle closure and a higher level of circular economy in the steel industry.
- Reduction of emissions or any other ways of pollution incl. the avoidance of use of hazardous materials in production plants.
- Process and technology modifications to speed-up adaptability of conventional production in order to move towards quickly adapt to the needs of low carbon steel making without losing the necessary steel product performance qualities e.g. solutions for efficiency upgrades and utilisation of scrap in steelmaking.
- Solutions to decrease the energy consumption, greenhouse gas emission and raw material consumption by increasing the production yield or moving toward a zero defect strategy along the complete steel making and processing chain.



Priorities – storyline (2)



Steel Annual Priority 2020

Priority: Pilot/demonstration projects of emerging and innovative technologies leading to emission reductions and industrial efficiency improvements. This will include the concept of zero-carbon steel making process in line with the spirit of the European Green Deal Communication.

- Significant improvements of energy efficiency of the complete steel production route by using waste heat (from gas, gas flares, fumes, water, solids; at low or high temperature), better use of steel plant gases or any other way to reduce energy consumption, e.g. smart integration of renewable energies in steel plants (e.g. solar, wind, geothermal, clean hydrogen), depending on the local potential, to cover some of its electricity and/or heat demand.
- Sustainable, efficient valorisation of residues and end-of-life materials for a conversion into valuable secondary raw materials for an enhanced material cycle closure and a higher level of circular economy in the steel industry.
- Reduction of emissions or any other ways of pollution incl. the avoidance of use of hazardous materials in production plants.
- Process and technology modifications to speed-up adaptability of conventional production in order to move towards quickly adapt to the needs of low carbon steel making without losing the necessary steel product performance qualities e.g. solutions for efficiency upgrades and utilisation of scrap in steelmaking.
- Solutions to decrease the energy consumption, greenhouse gas emission and raw material consumption by increasing the production yield or moving toward a zero defect strategy along the complete steel making and processing chain.



The Green Deal on the Road(map)

The current actions at EU level: the GreenSteel Project

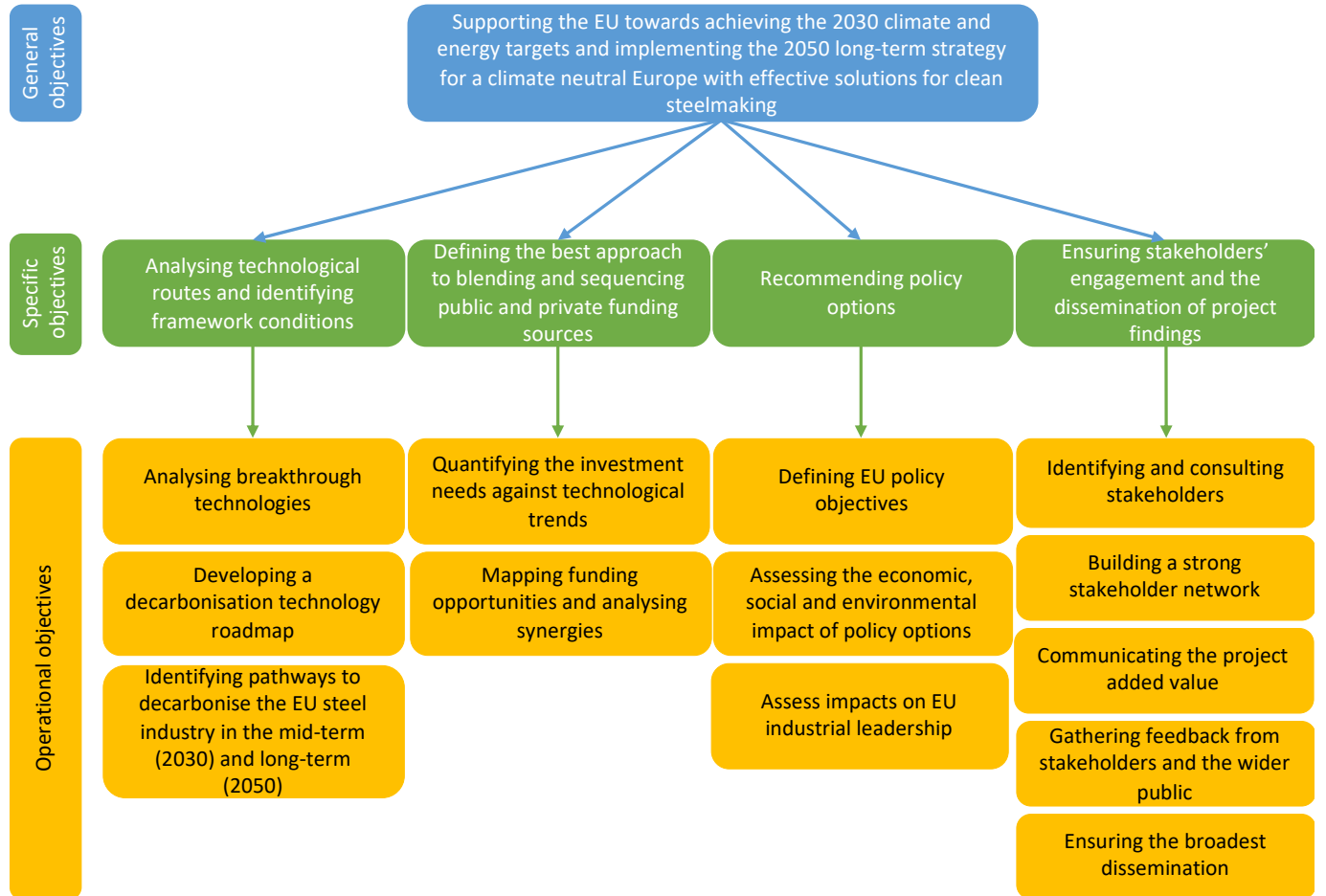
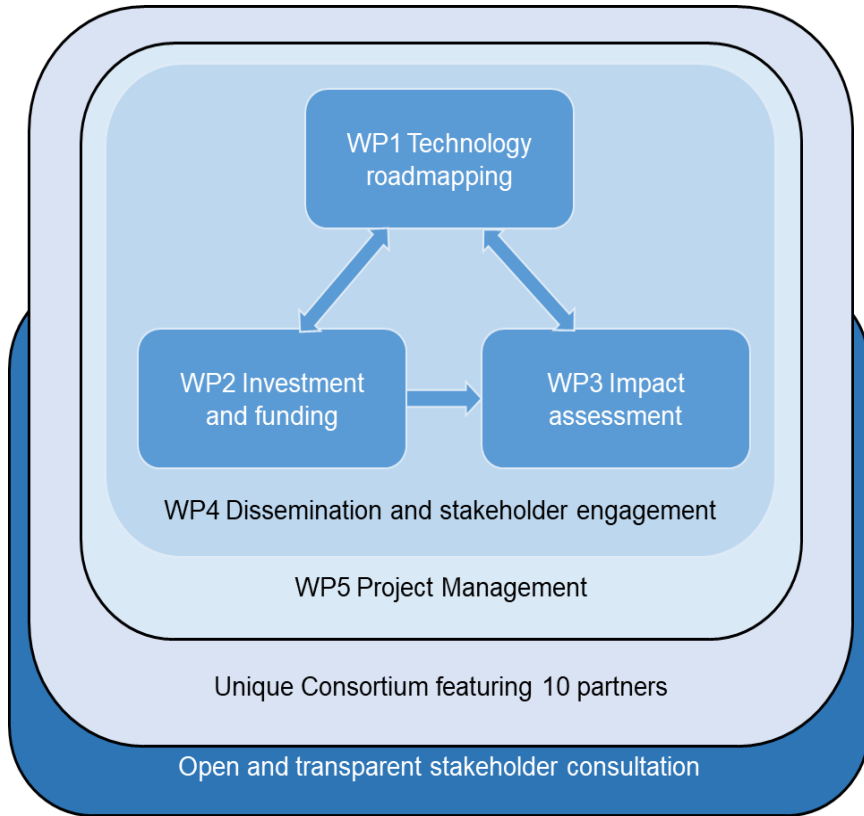


The Consortium



Adequate mix of RTO, Steel producers' associations & Entities with a Policy Think Tank for Leadership

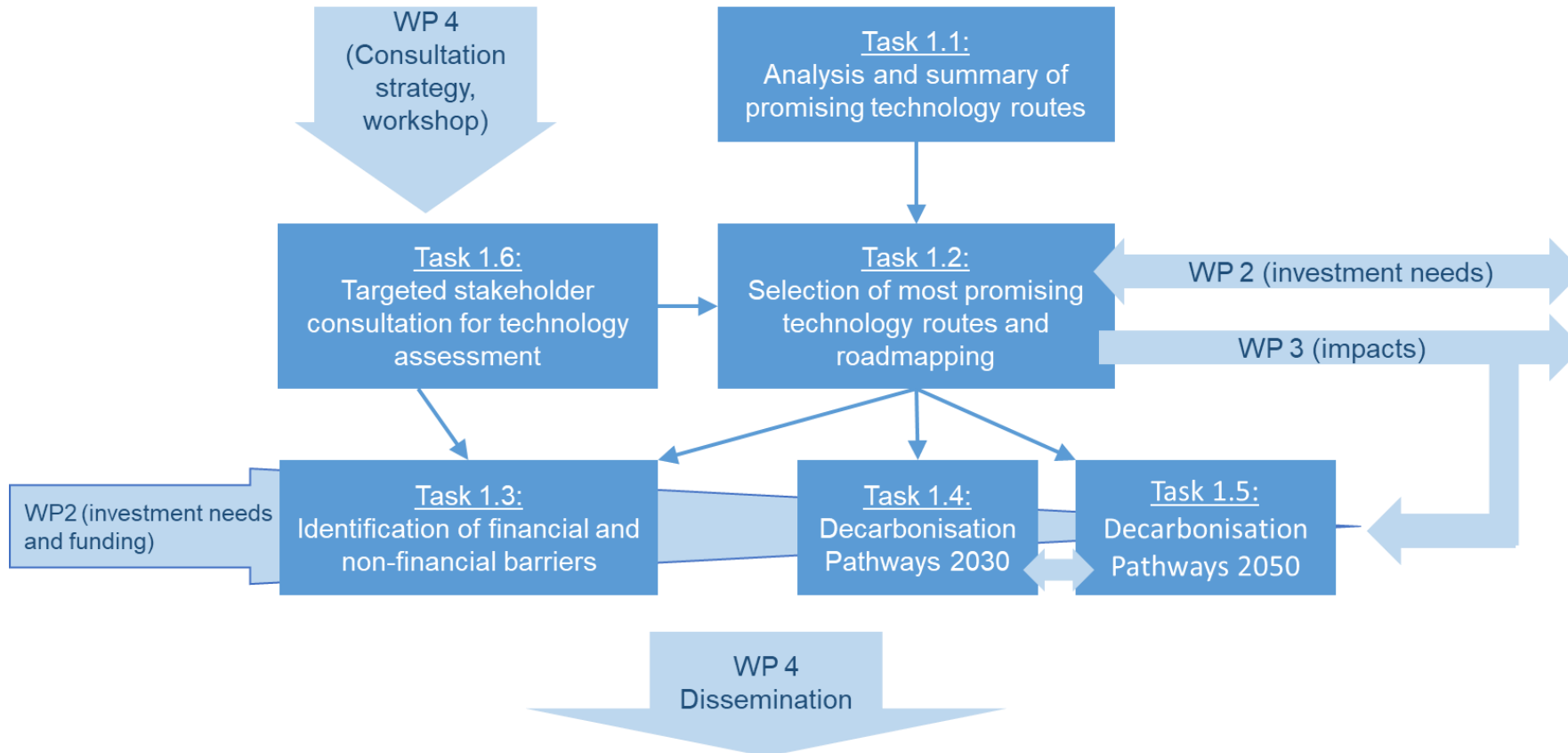
Structure & Objectives



Structure of the Project: the Workpackages



WP1 - Technology roadmapping



Structure of the Project: the Workpackages

WP1 - Technology roadmapping – main points

✓ Assessment and roadmapping of technologies

✓ 9 technologies

✓ 4 technology routes

✓ Collection of possible decarbonisation barriers

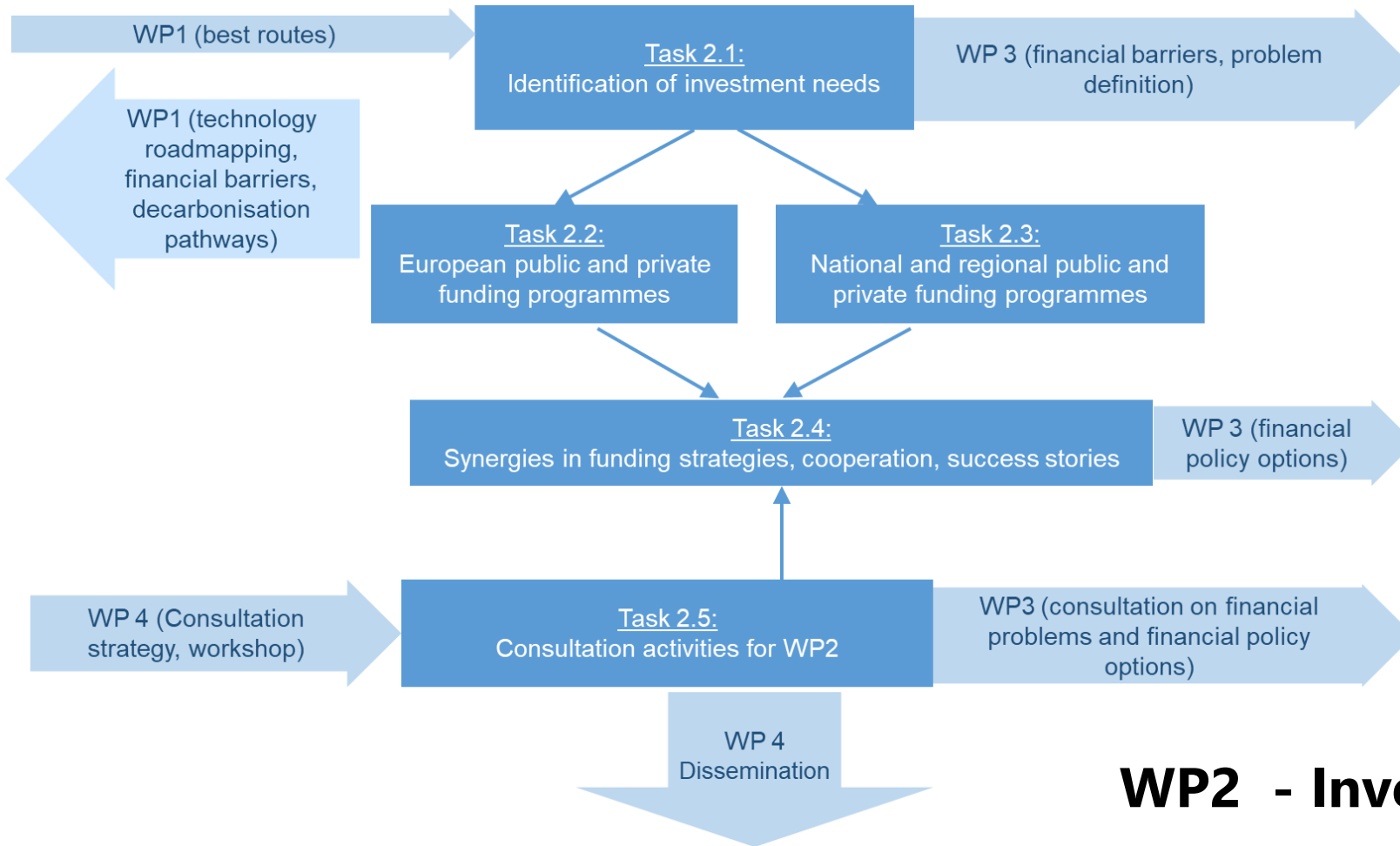
✓ 4 types of barriers (technical, organisational, regulatory/societal, financial)

❑ *Decarbonisation pathways for 2030 and 2050*

Consultation activities on WP1

- ✓ Consultation on technologies, barriers and industrial deployment (in-depth interviews and/or online survey)
- Interactive validation workshop (March 2021)

Approach and Objectives



WP2 - Investment and funding

Approach and Objectives



✓ Investment needs

- ✓ 9 technologies, 4 technology routes, 2 "auxiliary" technologies

✓ Funding opportunities

- ✓ 25 EU-level, 81 national and regional, 24 private
 - ✓ €2 billion (potentially) available at the EU level up to 2030
 - ✓ Additional € 400 million per year (potentially) available at national level (up to 2022)

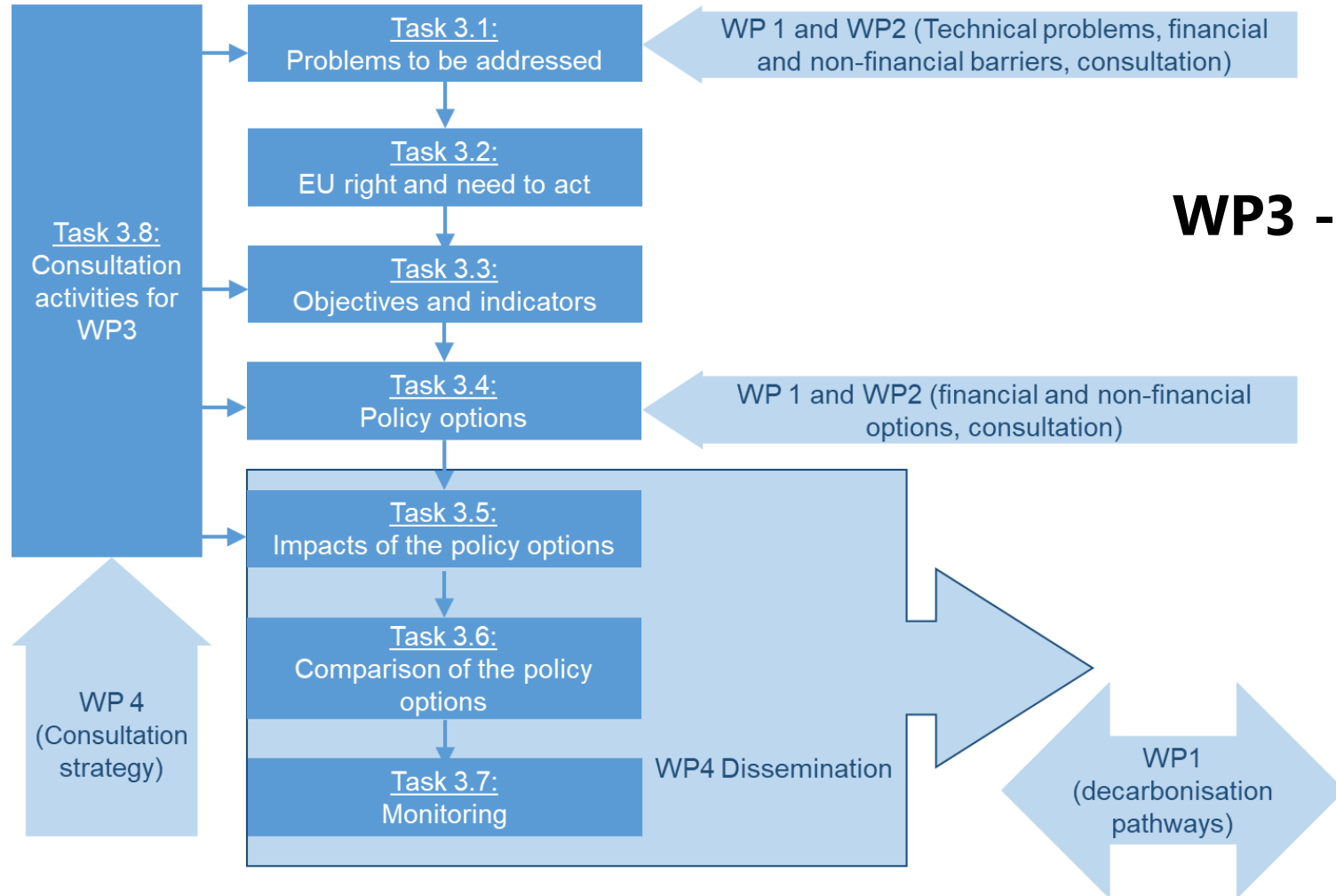
□ Guidelines and approaches for using funding sources

WP2 - Investment and funding – main points

Consultation activities on WP2

- ✓ Consultation on funding programmes (to which steelmakers have accessed to update their production process) and future developments (in-depth interviews and/or online survey)
- Interactive validation workshop (March 2021)

Approach and Objectives



WP3 - Impact assessment

Approach and Objectives

Problem definition

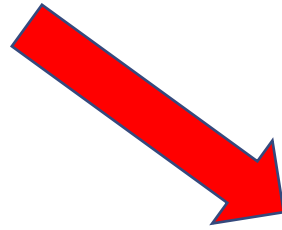
Policy objectives

Policy options

Impact assessment

WP3 - Impact assessment – main points

1. *Renewable electricity (supply, costs, variability)*
2. *EU carbon pricing (price level, incentives, carbon leakage)*
3. *Carbon capture, usage or storage (storage, capture process, climate neutrality, cross-chain effects)*
4. *Green hydrogen (supply, costs, cross-chain effects)*
5. *Iron and steel scrap (extra-EU demand, limited quality)*
6. *Funding (costs of low-carbon steel, investment risk, limited public funding)*

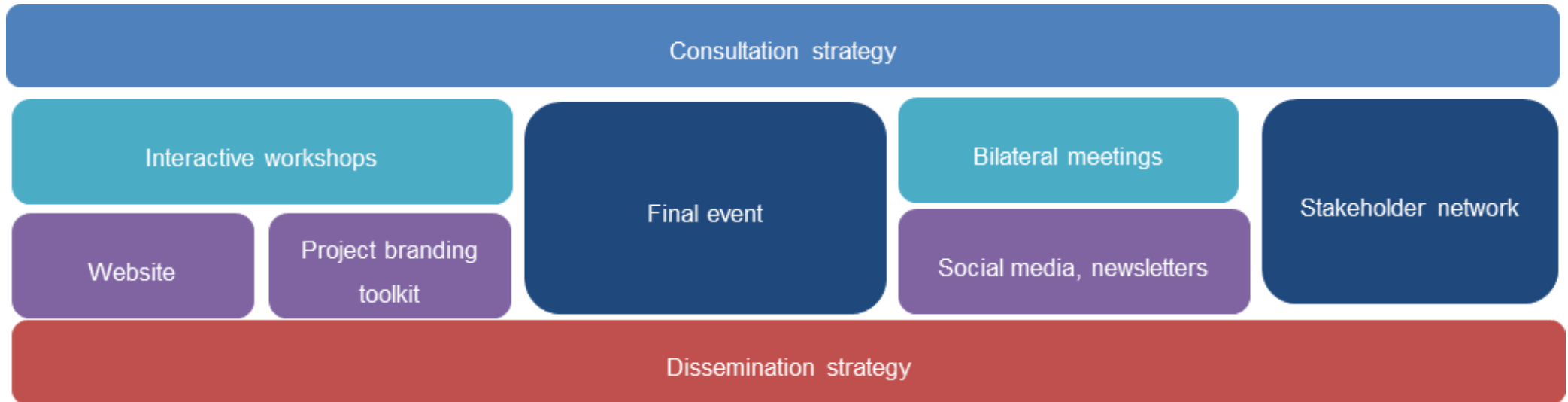


Consultation activities on WP3

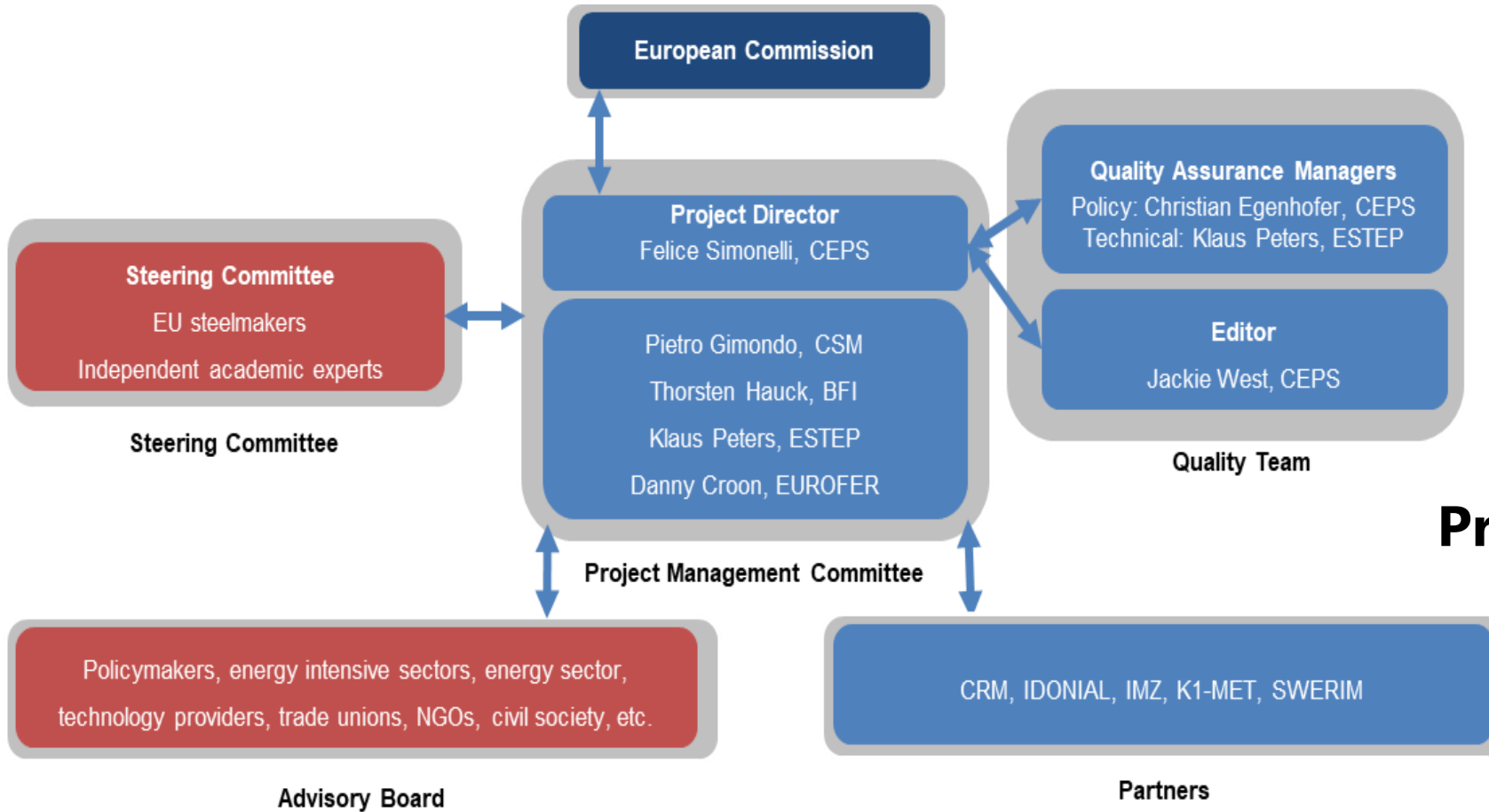
- ✓ Online survey to identify the policy problems (October-November 2020)
- ✓ Online survey to shortlist the policy solutions (December 2020)
- Public consultation on expected impacts of the proposed policy solutions (February-March 2021)
- In-depth interviews on expected impacts of the proposed policy solutions (February-March 2021)

Approach and Objectives

WP4 - Dissemination and stakeholders' engagement

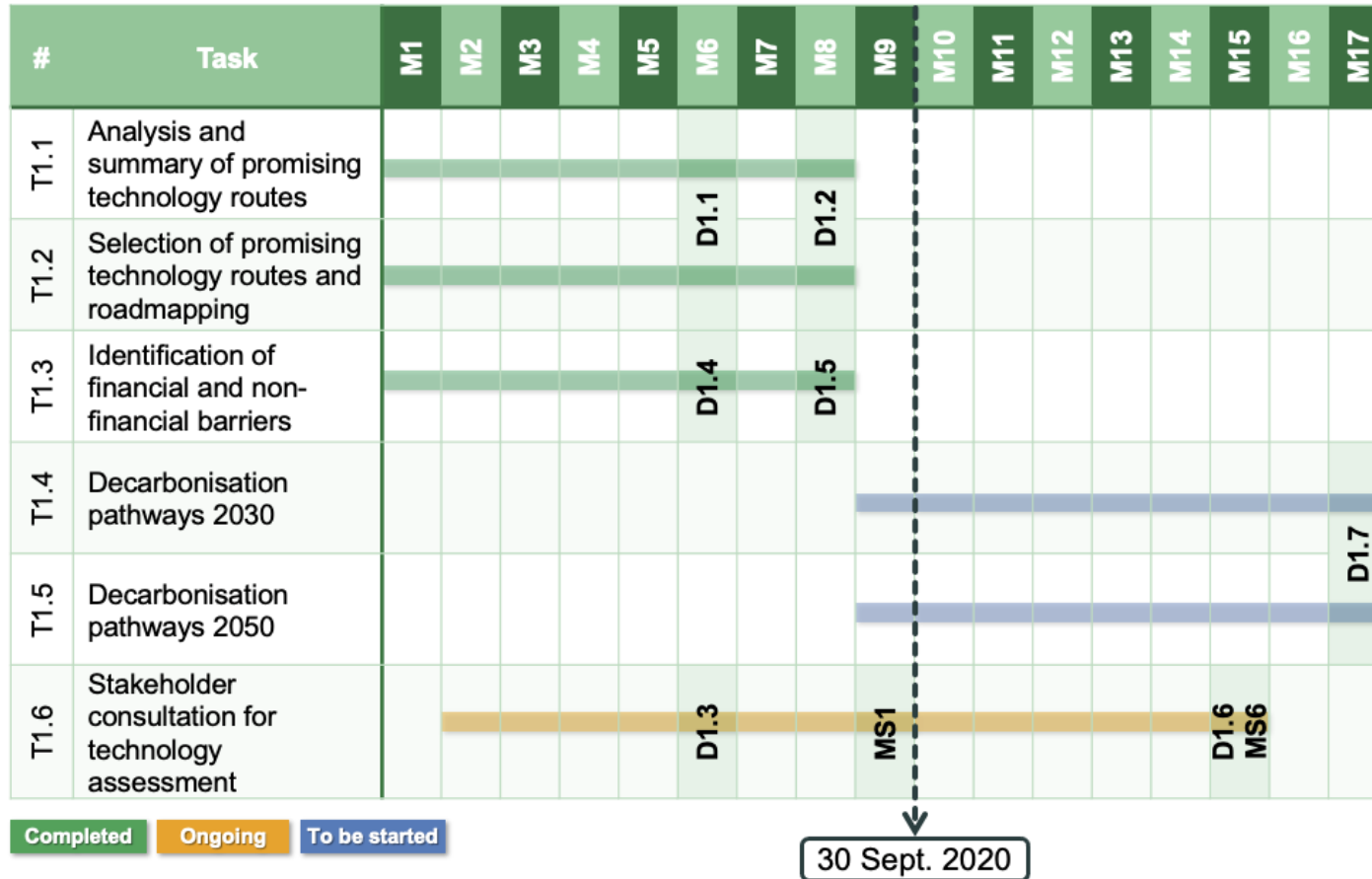


Approach and Objectives



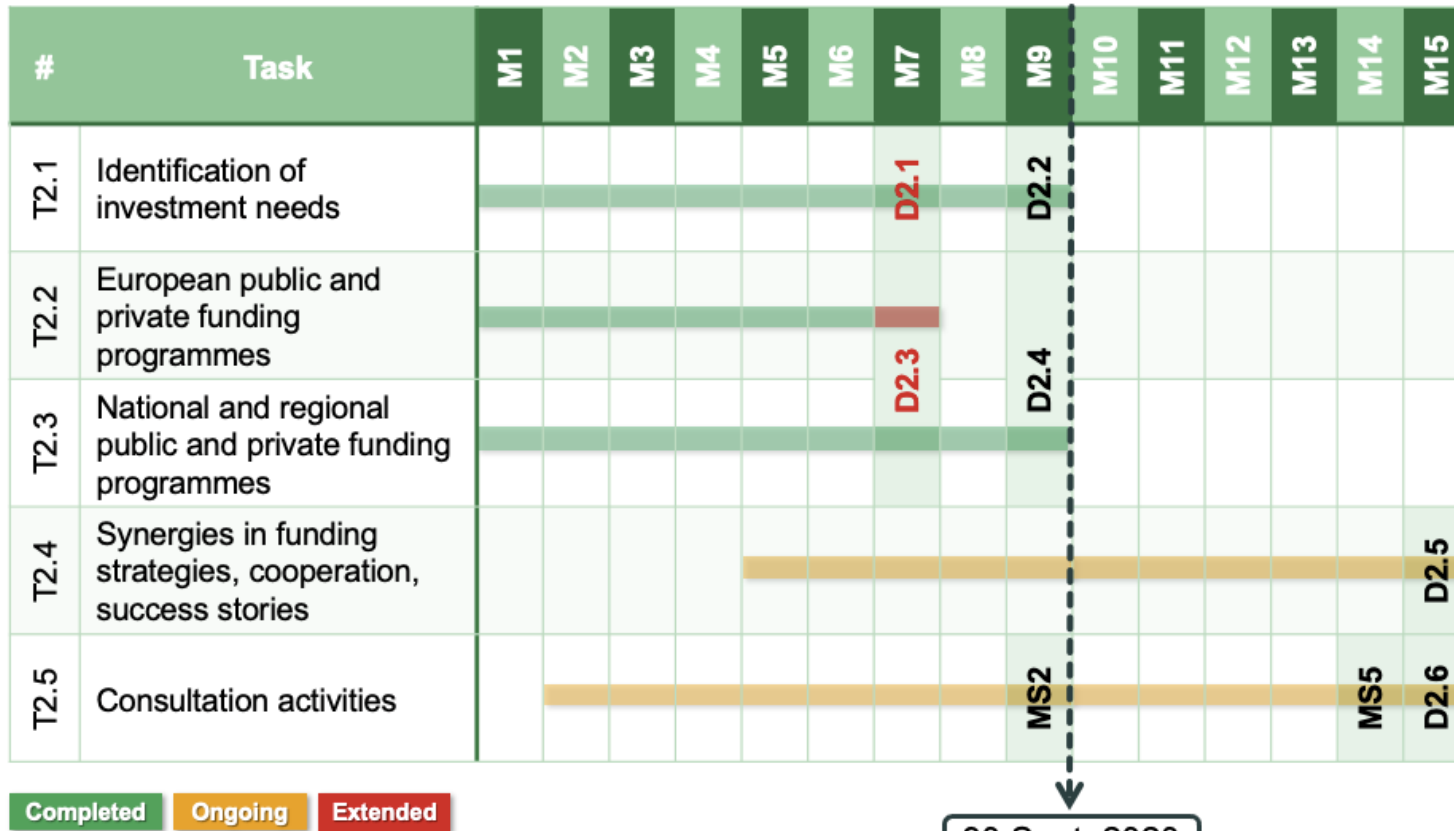
Project management

Storyline – State of the art



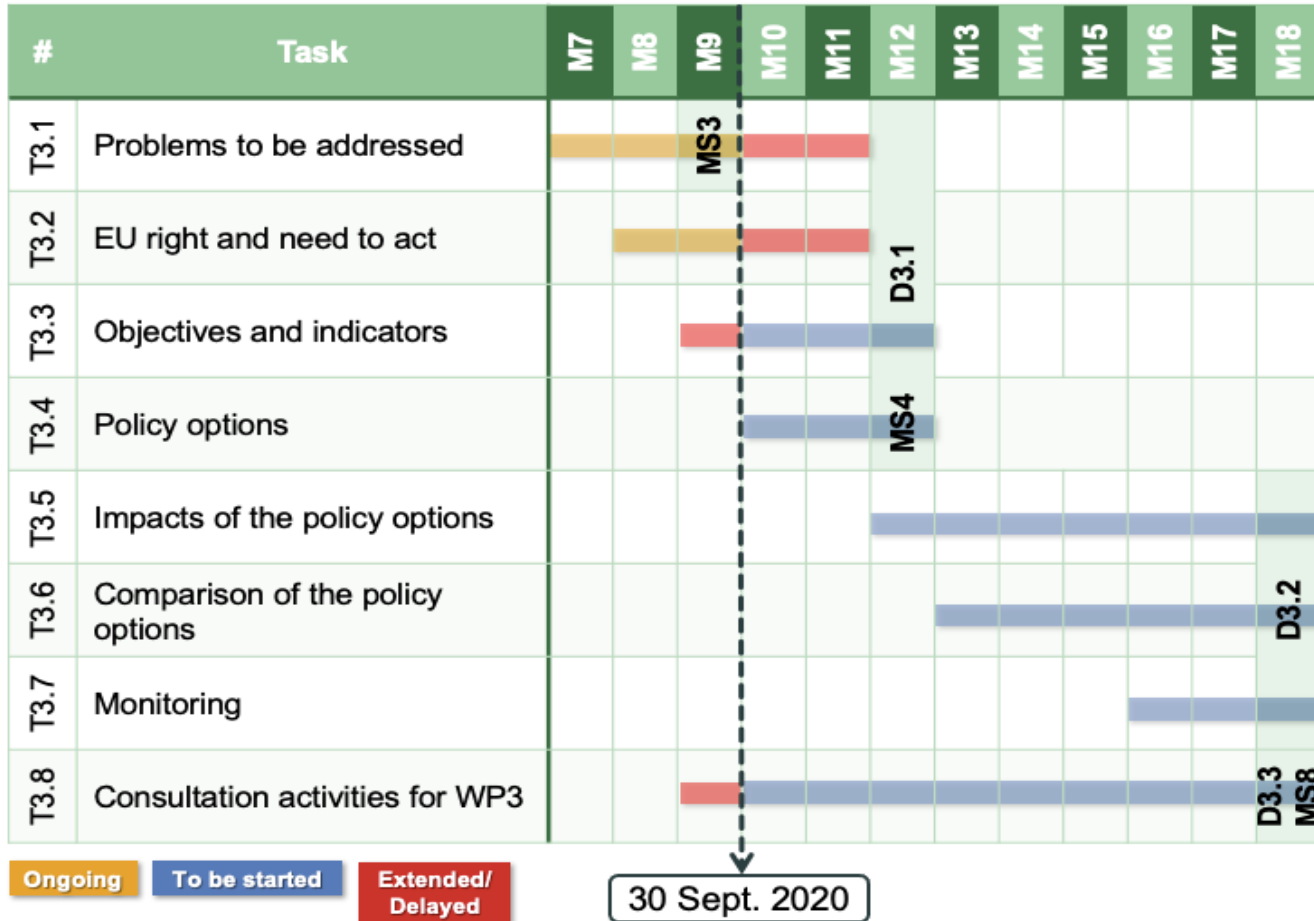
WP1 - Technology roadmapping

Storyline – State of the art



WP2 - Investment and funding

Storyline – State of the art



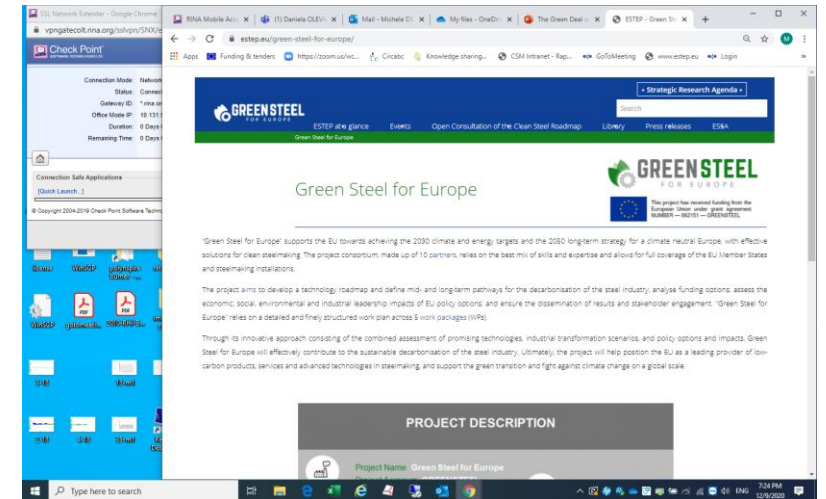
WP3 - Impact assessment

Contacts

Thank you!

Felice Simonelli – greensteel@ext.ceps.eu

Website: <https://www.estep.eu/green-steel-for-europe/>



This project has received funding from the European Union under grant agreement NUMBER — 882151 — GREENSTEEL



Thank you for your attention!

