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Tackling covid-19 crisis through energy efficiency investments: Decision support tools for economic recovery

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1. Introduction

The covid-19 pandemic has unleashed unprecedented shocks across all aspects of society. Especially, the energy sector is in no exception, with concerns being raised about how governments and private sector will recover from the economic recession but continue working towards clean energy transition. Firm commitments and targeted energy efficiency (EE) investments are required. This study’s aim is twofold; firstly, a review on the energy sector crisis with the critical role of EE investments and the investigation of available Decision Support (DS) tools to boost such recovery. The methodology followed by a review on strategically selected countries to capture their energy recovery needs and strategies. Results showed that EE investments will assist in countering pandemic recession, therefore, innovative DS tools and standardisation methods are required. However, hardly any tool exists identifying sustainable investments with strong potential to meet their commitments. The Triple-A Horizon 2020 standardised tools are considered to play critical role enabling EE projects to get financed towards assessing the EE investments’ risks.

The International Energy Agency (IEA) points out that targeted EE investments could boost economies by creating jobs and bring long-term benefits for consumers, businesses and environment, in particular, lower energy bills, reduced greenhouse gas (GHG) emissions and improvements in energy systems [5]. The current covid-19 crisis brings the opportunity to introduce structural changes in the world and to leave jobs with low productivity and added value towards modern economy.

The IEA published a series of strategic recommendations to policy makers, where three categories of EE investments are proposed to be investigated by governments and included in their economic recovery plans. These include buildings (construction and energy efficiency renovation), technology replacement by energy efficient models, and efficiency improvements in energy systems [5]. The current covid-19 crisis brings the opportunity to introduce structural changes in the world and to leave jobs with low productivity and added value towards modern economy.

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1. Introduction

The covid-19 pandemic has created the biggest global crisis of the last decades, impacting health systems, economies and societies around the world. The severe effects from the covid-19 crisis are not temporary and in combination with the threat posed by climate change, recovery plans should be drawn up to counter the damage created [1].

Energy Efficiency (EE) actions, as technological changes that make energy consumption more efficient, thus lowering demand could play a vital role in national economic recovery plans, since investments in EE are readily returned through energy savings and other benefits, such as raise in asset value, reduced air pollution or increased employment [2]. Attention to EE has begun to evolve in this respect even before pandemic crisis, and as a result its past identification as the “hidden fuel” has progressed to an increasing recognition of its role as the “first fuel” [3]. EE has been considered as the base pillar of the energy transition along with the renewable energy sources [4].
However, covid-19 pandemic poses negative and unpredicted consequences in the economy which increased more confusion, lowering trust, creating turbulence in economic market and increasing uncertainty among investors [9–11]. Indeed, capital flows in EE projects related to environmental pollution have been decreased [12].

To reach EE investments, mobilisation of capital through a targeted use of funds, innovative decision support (DS) schemes and standardisation tools for the respective key actors are required [13]. These could assist in securing EE investments that could meet their financial commitments, which is of great importance considering the economic volatility triggered by the pandemic. EE investments are inherently risky investments as they have emerged as interdisciplinary challenge that are being affected from a wide range of perspectives [14] as proved by the current pandemic crisis. Standardised methodology is required to assess the risks involved from the first stages of investments generation and pre-selection/pre-evaluation. Therefore, DS tools are needed to help investors and policy makers to choose the most profitable solution [15].

The up-to-date review indicated that there are available tools focusing on assessing obstacles to mainstreaming EE investments, such as risk identification [16–19], energy performance [20–22], funding scheme and models [7,23–27]. Although the aforementioned studies contributed to the overcoming of EE efficient investments barriers from different views and the existing methodologies, in the chaotic and emergent environment under covid-19 pandemic, more contributions are not enough, and it is beneficial for the whole energy market and society by providing more holistic perspectives. It is evident that hardly any tool identifying sustainable investments exists, assesses them in terms of risks and benchmarks them, facilitating the access to capital markets for EE investments and addressing the lack of standardisation of assets.

The aim of this paper is on the one hand to capture the pandemic effects and challenges in EE sector in specific case study countries, and on the other hand to provide a review on available DS tools and their potential to boost EE investments through the identification of attractive EE projects ideas and enable them to get financed. Therefore, this paper has investigated the impact of the pandemic crisis on the energy sector, as well as discusses methodologies to enhance recovery towards clean energy transition and applicable ways to boost the efficient implementation of these measures.

In particular, the study focuses on reviewing the role of EE investments during covid-19 along with the potential of practical and result-oriented DS tools which focus on making EE investments more transparent, predictable and attractive to investors and financiers. Discussion on capabilities of DS tools concludes to most promising along with analysis on objectives required to fulfill. The EU Horizon 2020 Triple-A Tools developed towards this direction provide functionalities to energy efficiency project developers and financing institutes linking profitable, EU Taxonomy compliant energy efficiency project ideas to real financing schemes playing a critical role in enabling EE projects to get financed. Such approach will foster greater and securitised progress towards assessing the risks involved with energy efficiency investments. The four case study countries are being analysed and compared, namely Czech Republic, Germany, Greece and the Netherlands, represent countries with different impact occurred by pandemic effects in order to capture diversity on how pandemic crisis is being faced. The scope is to highlight differences and similarities from challenges arose by covid-19 crisis and conclude to impacts on energy sector and measures overtaken.

At the next section, the paper is structured along as follows; section 2 provides a review on energy sector effects, section 3 investigates the role of EE investments during the pandemic crisis, section 4 presents a review of up to date DS tools to enhance the energy recovery plans, section 5 highlights the importance of the EU taxonomy criteria for reliable DS tools and finally section 6 presents the four case study countries and their experiences facing covid-19 challenges in energy sector and EE in general in order to set a baseline for investigating measures to be implemented for economic recovery.

2. The economic slowdown and pandemic effects in energy sector

The covid-19 pandemic has spread around the globe with an alarming speed. The economic damage is already evident and represents the largest economic shock the world has experienced in decades [28]. Global growth is projected to decline by approximately 5% in 2020 [29, 30]. This decline has been characterised as the deepest global recession in decades, despite the extraordinary efforts of governments to counter the downturn with fiscal and monetary policy support measures [31]. Every region is facing a substantial downturn with the advanced economies to face the most significant downgrade. However, these downturns should set the alarm for global coordination and cooperation for innovative measures to deliver support in every sector that faces remarkable damage. The pandemic has significantly affected all aspects of life including the energy sector, and governments focus on bringing the pandemic under control, revive their economies and support businesses and economic sectors that have been affected [32]. The economic upheaval that this virus is causing has revived the memories of the biggest financial crisis that the world faced in 2008–09. However, world economy experiences worst recession than the financial crisis. The covid-19 pandemic is exerting a more radical and abrupt effect. It has put the economy out of action immediately, evaporating supply and demand simultaneously [33].

Data from April 2020 showed that countries with a full lockdown saw on average a 25% drop in energy demand per week, while partial lockdowns resulted in a decline of 18% on average. Data from the Global Energy Review (2020) indicated that globally electricity demand decreased by 2.5% in the first quarter of 2020 due to the first period of lockdown posed in many countries, while demand for gas and oil dropped by 2% and 9% respectively [34]. Several countries that fully locked down their economies experienced a reduction of 20% of electricity demand. In Europe electricity demand was affected most in the countries where the virus hit the hardest and full lockdowns were enforced, i.e. in France, Italy, Spain and the UK. In these countries, electricity demand dropped by at least 15%. Moreover, an extraordinary decline in mobility (~57% of global oil demand) was observed [35].

The challenge that arose due to the covid-19 pandemic is a test of governments and companies’ commitments to clean energy transitions. The focus on the immediate public health and economic crises has largely relegated climate and environmental concerns to the background. Action plans easily fade when market conditions become more challenging. The pandemic has resulted in lower energy prices, and these reduce the appeal of EE measures for consumers and business alike. Next to this, business cases for renewable energy have been put under pressure [36]. As a result, the energy transition may slow down. Although CO2 emissions may fall this year as a result of the impact of the coronavirus lockdown, this is a short-term result only. Governments and companies should remain committed to effective low or zero carbon energy policies and strategies.

Indeed, lessons learnt from previous financial crisis in 2008–2009, show that at that time, multiple governments implemented green stimulus programs, reasoning that a greater commitment to renewable energy development could ensure economic development in the short run while providing long-term competitive benefits. However, and at a first glance, covid-19 pandemic is so unlike with financial crisis in 2008–2009 as today’s pandemic primary challenge is to respond first at the health crisis and not to sustain the economy. Still, despite this significant difference, governments stimulus packages focused on accelerate sustainability and energy transition in both cases [37].

It should also be noted that although EE has tremendous potential to boost economic growth, the global progress was slowing down even before covid-19 with opportunities to reduce costs and emissions to have been lost. This slowdown was due to a mixture of societal and economic trends. An important factor of this slowdown is also the exceptional weather conditions due to climate change that have pushed up the
energy demand. However, policy and EE investments had been remained flat without making significant progress on pressures towards EE directions. In addition, although technical efficiency improvements presented an increasing resulting energy savings, these savings are overwhelmed by wider factors (populations, weather changes, increasing in floor area per person etc.) [38]. Digitisation could also play important role to scale up EE despite the risks imposing and the new way of thinking and policy making that are required.

It is more than evident that strong principles have to be established for sustainable recovery and resilience so as countries to be ready for unforeseen shocks. Efficient and effective recovery provides the opportunity to rebuild beyond pre-crisis conditions for more sustainable, safer and more resilient built environment. All actions should be designed so as to reduce vulnerability against the volatile future which consequently will ensure significant lower impacts in all aspects in case of future crisis.

3. Energy efficiency investments and their role during covid-19

The EE sector, a significant pillar of clean energy transitions, is suffering due to the covid-19 crisis. EE investments are expected to fall by an estimated 10–15%, as vehicle sales and construction activity weaken and spending on more efficient appliances and equipment is dialled back [32] although a global environment efficiency growth had been observed the latest years [39,40]. It has been noted that capital flows in EE projects related to environmental pollution have been decreased [41] Due to the sharp decline of the oil price resulting from the coronavirus lockdown measures, the implementation of EE policies’ impact decreased as cheaper energy always leads consumers to use it less efficiently, while reducing the appeal of buying more efficient cars or retrofiting buildings to save energy [42].

In several countries, the EE sector is experiencing mass layoffs resulting from the pandemic as mainly utilities and companies and most unfrequently governments have halted programs that help for building retrofits both for residential and commercial customers. An analysis of unemployment data released recently by Environmental Entrepreneurs and other groups found that nearly 70,000 workers in the field of EE lost their jobs in March alone [43]. According to the American Council for an EE Economy, 20 USA states have halted all retrofits to low-income homes under the federal Weatherization Assistance Program [44], while all residential EE work has been suspended by utilities, states, service providers, and small businesses. The situation in Europe is due to the many social measures programs took place immediately and increasing of unemployment rate could be expected mainly in the second half of 2020 and first half 2021 [45].

However, as the economic downturn has deepened, attention has shifted towards addressing opportunities to recover in an even better condition. While the impacts from the covid-19 pandemic are severe, the crisis could offer an opportunity to help the implementation of the clean energy transition, including an acceleration of EE investments. There are increasing calls to develop a greener fiscal response, in order to ensure that climate goals are not sacrificed [45,46,47]. The IEA published a series of strategic recommendations to policy makers [48], in which three areas for EE investments are identified. These comprise buildings and construction, including both renovations and new buildings; technology replacement by energy efficient models (e.g. by consumers, retailers, or manufacturers); and large-scale infrastructure projects that may enable greater energy efficiency. Examples of the latter category include smart grids, electric vehicle charging, improved digital connectivity, or the creation of cycling lanes. There are evidence-based studies showed that investments in green energy technologies prompts sustainable green economy by ensuring a reduction in the per-unit energy cost [49-51].

Targeted investments in these areas and as described in Fig. 1, could create jobs immediately as EE is job intensive even before pandemic crisis. Moreover, EE investments could bring long-term benefits for consumers, business and the environment, in particular through lower energy bills, greater comfort, reduced greenhouse gas emissions and improvements in energy systems. In addition, EE investments could improve worker health and productivity. Investing in EE continues to be cheaper than conventional electricity or gas for utilities to meet customers’ needs. Moreover, using less energy will reduce the need for investments in transmission and distribution energy systems and diminish customers costs in general [7,52].

The European Commission (EC) has included EE in its plans for a comprehensive green recovery of the European Union (EU) economy. The EU recovery plan builds on the Green Deal launched late 2019 [53]. Investing in clean and digital technologies and capacities, together with a circular economy, will help create jobs and growth and allow Europe to make the most of the first-mover advantage in the economic recovery. Apart from promoting investments in clean technology, notably through the Horizon 2020 program, the Commission aims to double the annual renovation rate of the existing building stock [54]. To meet these

![Fig. 1. Key reasons to invest in Energy Efficiency.](image-url)
objectives the existing capacity in the EE workforce must be maintained. However, companies in the EE industry are currently under pressure [55], and it is vital that these are upheld during the crisis. EE consulting companies, organizations and workers have been alarmed and intended to raise awareness of the situation. For example, in the US E4TheFuture, a consulting company that promotes EE, has set up a platform where EE companies and workers can share their personal experience of how the pandemic has affected their business. By collecting such information, E4TheFuture aims to raise the awareness of legislators in order to “do what it takes to help EE and clean energy businesses survive and recover” [56].

Transitioning from fossil fuels to a sustainable, low-carbon economy after the covid-19 crisis will require firm commitments of public spending and pricing reforms. Public spending should prioritize supporting the private sector in advancing green innovation and infrastructure, development of smart grids, transport systems, charging station networks, and sustainable cities [46].

In order to meet EU’s climate and energy targets, capital flows need to be reinforced towards EE projects for more resilient economies, societies and climate in general. Therefore, EU taxonomy tries to address challenges and clearly define a common classification system for environmentally sustainable economic activities. EU taxonomy is the way to scale up EE investments, so as to ensure that the Green Deal’s targets will be achieved. For that reason, there should be clear policy signals for creating reliable and robust frameworks for EE investments in both private and public sectors [57].

EE investments have the potential to play a crucial role in transitioning to an economy where sustainable growth will be the centre of attention. Making sure that EE investments can meet their commitments is critically important in a fragile economy [13]. To this end, new initiatives and DS tools have the potential to play a crucial role for a successful recovery plan as reduced respective time and effort is of great importance along with an increased transparency and efficient decision-making methodologies. They could decrease the uncertainty felt by investors in the performance of EE investments and build their confidence that such investment could be attractive at low risk.

4. Decision support tools to boost energy recovery plans

The EU proposed a €750 billion fund for recovery from the economic crisis triggered by the coronavirus and emphasized the need for a green recovery and climate action. 25% of this amount must be directed towards climate investments and additional funding for Horizon Europe [58]. Fatih Birol, head of the IEA, publicly asked for governments and international financial institutions to put the clean energy transition at the heart of stimulus packages [59,60]. The challenge now is to combine international financial institutions to put the clean energy transition at the heart of stimulus packages [59,60]. The challenge now is to combine international financial institutions to put the clean energy transition at the heart of stimulus packages [59,60].

In terms of new financial models, the SENSEI project [63] designs and tests innovative transaction models that enable EE upgrades. SENSEI aims at creating new business models based on innovative pay-for-performance P4P schemes. In P4P schemes, EE is taken as tradable energy source. A Pay-for-Performance (P4P) model allows to savings to be offered on a bidding platform. This approach encourages long-term investment and transparent cash flows (pay) in energy-efficient buildings by metering energy savings smart and getting a return on investment, based on proven and measured savings in the buildings (performance). Payments for EE are based on proven and measured savings (using pre-agreed measurement and verification methods).

Another possible way of financial models’ decision support suggests alternation in the relations between the government and the business community within the framework of the public-private partnership (PPP) mechanism [64]. This supports the public authorities in the decision-making process to develop an energy efficiency project as a PPP so as the interaction and mutual trust between the state and society to be ensured [65,66]. This kind of partnership also provides the benefit of combination the private sector technology and innovation with public sector incentives to complete work on time and within budget, which may accelerate the whole process of the project implementation.

Standardised process of development, documentation and measuring uses the Investor Confidence Project (ICP) to unlock access to financing for the building, industry, district energy and street lighting markets. With a suite of Commercial and Multifamily Energy Performance Protocol (CPEP) in place, ICP reduces transaction risk by assembling existing standards and practices into a consistent and transparent process that promotes efficient markets by increasing confidence in EE as a demand-side resource. A set of Energy performance protocols define a clear roadmap for developing projects, determining savings estimates, and documenting and verifying results. These standards and protocols are basis for CP’s Investor Ready Energy Efficiency™ (IREE™), an international certification that ensures best practices, the right professionals and third-party validation are used to deliver high-quality projects that EE projects in industry. The database has various options in displaying data overview, statistics and indicators of energy saving projects. The platform also offers Analysis Toolbox and benchmark service that allows benchmarking the projects of the user (which can be added and managed via system) against the projects of the Deep Platform database. The EEFIG Underwriting Toolkit provides a common framework for evaluating EE investments and analysing the risks that will allow training and capacity building around standardised processes and understanding.

Another approach is via identification of multiple benefits of EE, which is an approach to quantify and communicate the strategic impacts of investments that enhance energy performance. The project aims at including the MBs of EE -such as improved product quality, enhanced employee productivity, and better indoor air quality-in investment decisions of companies and thereby substantially increasing the deployment of cost-effective energy saving potentials.

Related to financing there was established large initiative called Energy Efficient Mortgages Initiative [62], which consists of two projects, The Energy efficient Mortgages Action Plan (EeMAP) and Energy efficiency Data Portal & Protocol (EeDPP). Within the first one, a standardised energy efficient mortgage with preferential financing conditions (e.g. preferential interest rate and/or additional funds) for the evaluation of energy efficient projects will be developed. The EeMAP mortgage financing mechanism is intended to be supported by a data protocol and web portal delivered by the EeDaPP Initiative, in order to collect and access large scale empirical evidence related to the energy efficient mortgage assets and which will be made accessible through the design of a common data portal.

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you can bank on.

The SEAF project [67] enables investment in small to medium sized projects in Sustainable Energy Assets (SEA), such as demand response, EE and distributed renewable generation through a holistic online platform, eQuad, designed to function across Europe. The platform was developed with the primary goal of standardizing and simplifying the way to get access to finance for the small EE and renewable energy projects. The platform provides its users with the core services required to successfully evaluate a project from an investment perspective, include a core valuation module, access to insurance quotations, access to Investor Confidence Project certifications, as well as robust document management system.

5. EU taxonomy and standardised Triple-A tools

The current covid-19 pandemic has reinforced the need to redirect capital flows towards sustainable projects in order to make economies, businesses and societies more resilient against climate and environmental shocks and risks with clear co-benefits for health. To achieve this, a common language and a clear definition of what is “sustainable” is needed. This is why the action plan on financing sustainable growth called for the creation of a common classification system for sustainable economic activities, or an “EU taxonomy” [68].

The EU taxonomy entered into force in July 2020 and sets out the overarching conditions that an economic activity has to meet in order to qualify as environmentally sustainable, help investors, companies, issuers and project promoters navigate the transition to a low-carbon, resilient and resource-efficient economy. EU taxonomy has an important role to play in guiding both private and public sector recovery plans for the post covid-19 era, including the recently announced Roadmap to Recovery [69]. Thus, the importance of the EU taxonomy benefit towards this direction are not to be understated but boosted and promoted among key players.

However, the increased documentation, monitoring and necessary time to complete and monitoring use of proceeds, as well as significantly different sustainability and finance data reporting structures may delay the spread of EU taxonomy benefits. To this end, it would be important the combination of DS Tools that assist the financing and implementation of EE investments with EU taxonomy criteria and standards. In particular, DS Tools for EE financing should follow methodologies according to the needs of the end users removing barriers and providing pragmatic outcomes following policies. A collaborative and practicatory approach should be followed rather than only technical outcomes. This is the only way to ensure reliable EE investments that contribute towards EU targets and economic recovery.

It is evident that although several initiatives already exist to help towards successful implementation of EE investments, the main challenge lies in identifying which investments can be considered as investments fostering sustainable growth and have extremely strong capacity to meet their commitments. The “Triple-A: Enhancing at an Early Stage the Investment Value Chain of Energy Efficiency Projects” H2020 project [70] aims to provide the tools to identify attractive EE projects ideas and to enable them to obtain finance by also promoting the EU taxonomy. EE investments, being inherently risky investments (uncertainty about returns, a long time for realizing benefits), require a standardized methodology to assess the risks involve, from the first stages of investments generation and pre-selection/pre-evaluation, categorise them according to their performance in selected indicators and link them with potential financing schemes. Triple-A, by incorporating the EU taxonomy criteria and analysing this big amount of successfully completed ongoing projects (DEEP and SEAF) and feedback by stakeholders consultation [71], is targeting to elaborate and categorise financing instruments and risk mitigation strategies, as well as suggest the most suitable programs/models per case-study.

The core target of Triple-A is to identify the investments that could be considered as Triple-A investments, i.e. investments that foster sustainable growth, while also having an extremely strong capacity to meet their commitments, already from the first stages of investments generation and pre-selection/pre-evaluation. Triple-A Tools provide functionalities to EE project developers and financing institutes linking profitable, EU Taxonomy compliant energy efficiency project ideas to real financing schemes. Its scope is to facilitate access to capital markets for EE investments by addressing the lack of standardisation of assets. Hence, trust between investors that seek to finance certified Greek EU taxonomy compliant projects is built.

Triple-A methodology is implemented in three related tools (Table 1):

i. Triple-A Assess Tool assess results in the Member States (MSs) risk profiles and Mitigation Policies, including a Web-based database that enables comparability per MS and sector, exchange of experiences on good practices among the MS and facilitation of the replicability, leading to fruitful policy analysis for scaling-up EE investments and reducing uncertainty for investors/financiers. Complete risk assessment of projects and incorporation of EU Taxonomy eligibility criteria are the main pillars of the Assess step.

ii. Triple-A Agree Tool benchmarks the performance of the EE project ideas that successfully pass the Assess Tool. The benchmarking is based on the aggregated risk of the project, the predicted financial and energy savings data such as the initial project cost, estimated annual energy savings and annual operating costs, as well as Environmental, Social and Governance (ESG) criteria. The projects are categorised into three (3) classes: Triple-A, Reserved,Rejected. The most promising projects are marked as “Triple-A” projects, and their KPI results range in satisfactory values. In the case that a project has poor performance in the KPIs, it will be marked as Rejected by the Triple-A Tool. Tips and methods to increase the performance of the candidate projects are also provided.

iii. Triple-A Assign Tool links Triple-A investments ideas with possible financing schemes (Green Loans, Green Mortgages, Green Bonds & EE Auctions). It results in in-country demonstrations, replicability, and overall exploitation, including recommendations on what EE investments are feasible in the national and sectoral context, as well as on how they could be financed in practice.

Triple-A reinforces the EU taxonomy by following a Go/No Go approach about EE investments which should meet technical criteria set by EU taxonomy. In particular, with the three steps of Triple-A Assess

| Table 1 Benefits of Triple-A Tools for the EE projects financing. |
|---------------------------|----------------|----------------|
| Benefits for EE Financing | Triple-A Tools | |
| Assess Tool | Agree Tool | Assign Tool |
| Compliance with EU Taxonomy Criteria | ✓ | ✓ | ✓ |
| Questions parameterized on the EE project sector | ✓ | ✓ | ✓ |
| Assessment of the maturity of EE investments | ✓ | ✓ | ✓ |
| Use of Risk factors to assess EE investments | ✓ | ✓ | ✓ |
| Economic and Environmental Key Performance Indicators to identify the potential Triple-A investments | ✓ | ✓ | ✓ |
| Match making of the Triple-A investments ideas with the possible financing schemes | ✓ | ✓ | ✓ |
| Parametrizations of the variables according to the user needs | ✓ | ✓ | ✓ |
| Different interface of the tool according to the type of beneficiary | ✓ | ✓ | ✓ |
| Available database with EE projects seeking for finance | ✓ | ✓ | ✓ |
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6. National experience outlook

The pandemic effects and challenges in EE sector during covid-19 are analysed in four case-study countries, namely Czech Republic, Germany, Greece, and the Netherlands. The case study countries were strategically selected to reflect diversity across a number of dimensions. In this context, the case study countries include a leading European economy (Germany), an innovation front-runner in energy (The Netherlands), a weak economy going through one of the longest and most severe recessions (Greece) and also a progressing country with a sceptical stance towards low-carbon development (Czech Republic). Moreover, the selected case studies represent countries with different infection rates in order to highlight similarities and differences arose and actions undertaken during the pandemic crisis. The review of pandemic effects in the case study countries refers to the first half of 2020 and during the first phase of facing pandemic crisis where measures came into force suddenly and changes occurred in many sectors abruptly. This period presented higher interest as it depicts countries’ behaviour in unforeseen circumstances despite the different infection rates.

6.1. The case of the Czech Republic

The Czech Republic adopted strict measures as one of the first countries in EU. Therefore, the impact of covid-19 on the national health system compared to the other EU countries was not critical. The impact on the national economy was devastating and, thus, the government introduced full package of measures reducing impact of the closed economy on unemployment and business sector.

The decline in economic activity in the Czech Republic eased in the first half of May 2020. In the second week of May, electricity consumption decreased by 8.9% year-on-year, in the first week by 9.2%. In mid-April, this drop was 13.7%. Consumption is at the level after the 2013 recession. This is shown by data on electricity consumption as a proxy variable for estimating economic development in the absence of basic macroeconomic data. The level of economic activity is lower by 12.8% compared to the beginning of March 2020. In April, industry fell by 32.8% year-on-year (seasonally adjusted) [73].

The Czech-Moravian Guarantee and Development Bank (CMZRB) has ensured guarantees for businesses entities within the guarantee programs COVID Prague, COVID II and COVID III. The programs can finance, for example, wage and energy costs and rent payments [74].

The COVID Prague guarantee program facilitates access to operational financing for self-employed people, small and medium-sized enterprises active in the territory of the Capital City of Prague, following the mitigation of economic consequences caused by measures against the spread of the coronavirus infection known as covid-19 [75]. The CMZRB program was prepared in cooperation with the capital city of Prague and it is financed from the Operational Program Prague - Pole of Growth and is intended for financing projects implemented in the territory of the capital city of Prague. The CMZRB guarantee amounts up to 80% of the loan principal [74].

The COVID II guarantee program facilitates access to operational financing for sole proprietors, small and medium-sized enterprises. It is intended for those whose economic activities are limited due to the occurrence of the coronavirus infection and related preventative measures. The program is financed from the EU structural funds under the Operational Program Enterprise and Innovation for Competitiveness (OPPIK), and therefore is not intended for the implementation of projects in the capital city of Prague. The CMZRB guarantee amounts up to 80% of the loan principal [76].

The aim of the COVID III program is to support, through guarantees for operating bank loans, entrepreneurs with up to 500 employees whose economic activities are limited due to the occurrence of the coronavirus infection and related preventative measures. The CMZRB guarantee amounts up to 90% of the principal of a guaranteed loan for companies with up to 250 employees and up to 80% of the principal of a

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Fig. 2. Triple-A Assess Tool flowchart.
guaranteed loan for companies with 250–500 employees [74].

Financing of the national COVID programme could negatively influence financing of the EE measures in the country, if the sources are not returned back to the original funds. Nevertheless, a deficit of the national budget will be the highest in the history of the country.

The Government of the Czech Republic focuses on keeping of the current jobs and the payment of compensation to business sector most affected by the crisis. Till the end of June 2020, the government did not present any significant investment plan to increase influence of EE as an instrument of the fast recovery within the national economy. However, due to the approved deficit of the state budget around 20 billion Euro, in 2020 the EE funds will be kept in the country.

6.2. The case of Germany

Germany’s economic performance has been severely affected by the corona pandemic. As a result of the policy measure to contain the pandemic, the energy demand has fallen sharply, in particular due to the significant reduction in transport and traffic services and the lower commercial demand for electricity [77]. Among other things, this led to the fact that for the first time, renewable energies covered more than half of the gross electricity consumption in Germany, as those operators are allowed to feed their electricity into the grid with priority, thus forcing conventional power plants out of the market in view of the unusually low demand [78]. However, this is only a snapshot, but, as the Federal Minister of Economics Altmaier emphasized, Germany will enable the energy sector to contribute to economic growth and climate protection at the same time by heavily investing in energy-efficient and low-emission technologies such as renewable energies, building efficiency and hydrogen technology [79].

This is part of an “economic stimulus and crisis management package” and a “package for the future” totalling 130 billion euros, which the governing coalition has agreed on to stimulate the economy. Almost 60 measures are planned for 2020 and 2021, ranging from tax relief on value-added tax to investments in next generation technologies. With regard to climate protection, the package of measures foresees investments of around 25 to 30 billion euros. According to several experts, these packages contain many good approaches and impulses, but – if not supported by a consistent and sustainable climate policy – are at risk to fizzle out once the time periods of these stimulus packages have expired. In addition, important areas for climate protection such as investments in the circular economy are missing. Moreover, measures to increase energy efficiency are considered to not be given sufficient consideration [78,80].

The 15-page key issues paper summarising the results of the coalition committee of 3 June 2020 and published by the German Federal Ministry for Economic Affairs and Energy (BMWi), comprises a series of measures promoting “future investments and investments in climate technologies” [79]. These include, among others, allowances for R&D activities in next generation technologies, extensive investments and incentives in e-mobility and modernisation of, for example, public transportation or company car fleets, a national hydrogen strategy, an increase in investments in artificial intelligence and the Smart City Programme, as well as the expansion of future communication technologies. Into the context of EE, two measures are of relevance: “expansion of renewable energies”, and the “CO2 building refurbishment programme”. The first concerns the abolition of the funding cap for new solar systems (the “Renewable Energy Sources Act” (EEG) included a 52 GW subsidy cap for photovoltaic (PV) systems and an increase in the target for the expansion of offshore wind energy from 15 to 20 GW in 2030 [80]). As for the latter, the “CO2 building refurbishment programme” will be increased by 1 billion euros to 2.5 billion euros for 2020 and 2021. Further, the federal government’s funding programmes for the energy-efficient renovation of municipal buildings will be increased and a programme to promote climate adaptation measures in social institutions will be launched. Another measure, for which the Federal Government is providing a further 700 million euros for the conservation and sustainable management of forests, also provides for increased use of wood as a building material. In addition, the Smart City Programme, which was set up by the Federal Ministry of the Interior, Building and Community, will be increased by a further 500 million euros [79].

While the economic stimulus package, which was launched in response to the corona pandemic, has the potential to boost climate protection measures, this relationship also holds in the reverse direction. During the first quarter of 2020, a high demand for funding programmes that promote investments in EE and renewable energies in the building sector was observed (a total of 92,800 funding applications were submitted). According to Dr Ingrid Hengster, member of Kreditanstalt für Wiederaufbau’s (KfW’s) Board of Managing Directors, the demand for funding under KfW’s programme “Energy-efficient Construction and Rehabilitation” continued to be high despite the corona crisis [81]. Such subsidy programmes and the implementation of the related measures are expected to help mitigate the economic consequences of the covid-19 pandemic [82] and constitute an important impulse for the labour market in Germany [81,83]. Furthermore, according to a survey conducted by the Institute for Energy Efficiency in Production at the University of Stuttgart, the importance of energy efficiency in the industry has never been rated more highly. Over 30% of the respondents answered that the coronavirus has no influence on their energy efficiency strategy and will continue to maintain their existing strategy. Many companies have even expanded or brought forward their energy efficiency measures, as energy efficiency can help to reduce a company’s energy costs and increase its competitiveness, which is an important incentive especially now [84].

6.3. The case of Greece

Considering official statistical data, Greece has been one of the most successful countries in dealing with the covid-19 crisis. As measured by deaths as a proportion of the population, Greece has proved six times as effective as Germany, 27 times as effective as France, and 35 times as effective as the U.K [85].

This has been achieved by overcoming the difficulties that had to be dealt with, including (i) the second-highest population of people over 65 in the EU after Italy, (ii) a substantial proportion of the population (about a third) living in or near Athens, which is densely populated, (iii) a famously social people, and (iv) a great reliance on public transport. Moreover, after a decade of austerity the Greek public health system could be characterized anything else than robust and secured [86].

One of the peculiarities of this crisis is that every measure that helps in dealing with covid-19 crisis from a sanitary point of view, at the same time, hurts economy. Major economic impacts are expected because of the coronavirus lockdown measures undertaken. In the case of Greece, the consequences could be more severe than in other countries, since its economy heavily relies on tourism, one of the sectors that has been already crucially affected.

In 2019, tourism contributed 18 billion euros in revenue (around 10% of GDP) and supported 850,000 jobs (about 22% of employment) in the Greek economy. The Greek Minister of Tourism stated that even in a best-case scenario a 50% reduction will be faced this year and consequently a significant decrease in the country’s GDP as it is estimated that for every 1 billion of international travellers’ revenue losses, there is a decrease in the country’s GDP by 0.57% and a drop in the employment rate by 0.61% [85]. However, tourism is not the only sector that is currently affected by covid-19. Also, other important sectors experience setbacks. Exports in Greece are expected to suffer declines in 2020 as demand for Greek goods and services drops, an effect that is amplified by the large share for tourism and shipping in exports. Despite measures taken by Greek government, around 160,000 jobs are still at risk and consumer prices are expected to drop by 0.6% in 2020. Finally, investments may be cancelled or postponed under the uncertain economic
conditions.

The Greek energy sector had a great start of 2020 with significant investments in renewable energy [87]. The covid-19 pandemic however has caused concerns for the sector. Energy consumption is expected to fall 11% because of the coronavirus crisis impact on the economy. CO2 emissions are expected to be drastically reduced this year by 26.5% compared to 2019. This is not expected to be temporary, and the emissions will remain lower than the National Energy and Climate Plan (NECP) forecasts in the coming years [88]. Given the high dependency on oil and natural gas imports, Greece could benefit from the lower oil prices. Nevertheless, governmental aid for electricity bills for businesses affected by covid-19 and their employees has been announced. The Ministry for the Environment and Energy announced that a framework for the support of electricity supply companies affected by unpaid bills over the coming months is under consideration. This framework under consideration has prompted electricity suppliers to announce support schemes for consumers [99], such as the Public Power Corporation (PPC). Apart from PPC, other Greek energy suppliers have announced price reductions, not only for electricity but also for heating oil and car fuels [99].

Another action undertaken during the pandemic crisis was the Memorandum of Cooperation between the Greek Ministry of Environment and Energy and the Technical Chamber of Greece (TCG), which will cooperate towards the EE of building stock that will boost the construction sector and the successful achievement of targets established in the NECP. To this end, the promotion of EE in buildings plays the most important role, given that 40% of total energy consumption and more than 30% of GHG emissions are related to buildings. For that reason, the programmes “Exoikonomo kat’oikion” and “ELECTRA” will consider the establishment of new regulations/incentives for the upgrade of the old building stock with the poorest energy performance. This action will not only reduce energy demand, but also enhance indoor air quality of life in households and lead to a significant amount of new jobs [91].

In a nutshell, Greece has provided temporary relief to customers in the form of reduced energy bills, and measures have been taken to boost building renovations. Investments in renewable energy and large-scale infrastructure projects have become more affordable due to lower interest rates. These types of investments are expected to be more resilient than other energy forms, due to the stability of cashflows from underlying assets because RES sources are more independent by unforeseeable events (i.e., pandemic crisis) and monopoly manipulation of the conventional energy sources. However, problems in the international supply chain are expected to cause a slight slowdown for RES investments this year [87].

6.4. The case of the Netherlands

In The Netherlands an intelligent lockdown, which was called “Mid-March”, implied that people were to stay at home as much as possible, although they were allowed to go out, while gatherings were forbidden and eventually schools closed as well. Measures were gradually relaxed starting after the first week of May. By then, large parts of the economy have been affected, although the relatively mild lockdown has implied that the economic contraction will likely be less severe than in some other European countries. In addition, the Dutch economy was in good shape at the onset of the pandemic. Yet, the damage in some economic sectors has been substantial. Economic recovery in The Netherlands will likely be hampered by the country’s strong dependence on exports [92].

The pandemic has impacted the energy transition and CO2 emissions in The Netherlands. In the first quarter of 2020 CO2 emissions were 8.7% lower compared to the same quarter in 2019. Corrected for the relatively high temperature this decrease was 7.5%. Most of this decrease was because energy companies used less coal and more fossil gas for electricity production. Yet, the impact of the covid19-crisis was discernible as well. Aviation for instance emitted 11% less than the year before. The impact from the covid-19 crisis will stand out more clearly in the second quarter, in which the lockdown took effect and economic activity dropped by 10–15% [92].

For 2020 a drop in gross domestic product of 6% is projected [93], and this will impact both energy use and CO2 emissions. PBL Netherlands Environmental Assessment Agency (2020) has explored implications of the corona-crisis for CO2 emissions in two scenarios [94]. Initially, 2020 emissions were projected in the range 175.4–177.5 Mton (20–21% below the 1990 level). In the first scenario (‘short crisis’) CO2 emissions would drop by 6–7 Mton as a result from the pandemic, and in the second scenario (‘prolonged crisis’) this decrease would be 13–15 Mton. Other incidental factors would further reduce emissions by 2.5 Mton in both cases. The drop in emissions will be largest in industry, transport and in the demand for electricity. In agriculture emissions decrease insignificantly, and in the built environment emissions will be unaffected [95].

So far, the Dutch government has taken various measures to keep the energy transition going. Subsidized renewable energy projects that should be operational in 2020 may be delayed by one year, and startups, scale-ups and innovative SMEs can apply for coronavirus transition loans [96].

On the 24th of April 2020 the Dutch government announced additional CO2 reduction measures to comply with a recent supreme court ruling [97]. This ruling from December 2019 implied that emissions by the end of 2020 must be reduced by 25% compared to 1990. This will require additional reduction measures of 9–11 Mt CO2. Apart from advancing compliance with the verdict the package of CO2 reduction measures is intended to advance a speedy and green economic recovery. A range of actions was presented, including most importantly a measure to reduce CO2 from coal-based electricity production by 5–7.5 Mt.

Next to this, measures are taken for mitigating CO2 emissions in industry and the built environment. The government works with a number of companies to advance specific energy saving and CO2 reducing measures and will step up efforts to ensure that mandatory energy savings measures by Small and medium-sized enterprises (SMEs) are taken. The package also includes measures reducing energy use by tenants and SMEs, facilitating finance for homeowners, and supporting housing corporations that invest in greater sustainability of their dwellings. In the remainder of 2020 homeowners may benefit from a 50% increase in subsidies for energy saving measures. For refrigerators, a recycling premium of €35 will be introduced.

On the 20th of May 2020 the government also presented a plan to keep up the rate of construction and maintenance of dwellings. €20 million will be made available for accelerating procedures and licensing. Maintenance of government real estate will be accelerated using €15 million in 2020. Also, renovation of schools and sport accommodations adding to greater sustainability will be stimulated with €50 million. Another €50 million will be used to advance the construction of new homes in 2020 [98].

The Dutch Association for Sustainable Energy monitors the impact from the pandemic on the energy transition through repeated member surveys. The latest survey from June indicated that more than half of participating companies anticipate a modestly to very negative impact from the pandemic on national climate objectives [99]. Over 40% of survey participants, and smaller companies, expect a drop in revenue in Q2 of at least 10%. Expectations for Q3 are similar. Two thirds of companies serving consumers report that consumers postpone large investments. Interest among homeowners to invest in sustainability measures for their house has dropped markedly, although some are looking for ways to reduce energy bills.

The RES sector has made little use of the financial support measures offered so far. Apparently, the sector could handle some headwind. Still, dedicated measures for stimulating renewable energy and sustainable mobility are very welcome. Companies need government help in particular to warrant long term demand for greater sustainability and for reducing risks.
The slowdown in demand for sustainable energy also implies a greater emphasis on operations and a reduced focus on innovation. Yet some companies indicate that they experience more room to prioritize innovations on specific topics, such as digitizing advice to consumers, programs for housing renovation since many people are at home, digital participation methods, online education, smart grids, high speed rail to reduce air travel and more renewable energy to enhance energy security.

6.5. Discussion on case-study countries response to energy sector recession

According to analysis from case-study countries regarding covid-19 pandemic impact in their economies and especially in energy sector, it should be highlighted that shifting towards EE was found to have greatest potential to accelerate economic and consequently energy sector recovery. The case-study countries have weathered covid-19 relatively well with small differentiations to be presented in Czech Republic (when viewed through the lens of confirmed cases [100]). Fig. 3 presents the case study countries potential to accelerate energy transition along with EU cumulative potential according to their current impact of covid-19.

Moreover, through the implementation of the Triple-A methodology and the engagement with stakeholders, an important number of real EE projects have been identified and inserted in the Triple-A Tools for benchmarking. These projects are in their conceptualization phase and search of possible financing schemes to proceed to the development phase. The EE projects covered by the Triple-A project pertain to numerous economic activities, grouped in eight (8) distinct sectors (from now on: the Triple-A sectors). These sectors are Buildings, Manufacturing, Transportation, District Energy Networks, and Outdoor Lighting. The distribution of projects per case study country and per Triple-A sector is depicted in Fig. 4. It is obvious that Buildings is the most popular sector in the four case study countries.

In general, for European countries, promoting innovation to drive energy transition is not new as described in Section 2. Consequently, their fiscal position is sufficiently strong to adopt measures to boost EE investments which are considered as a high priority towards an economic recovery. It should, however, noted that Greece, Germany, and The Netherlands are presented to be leaders in response in energy sector enhancement during pandemic crisis. For that reason, and now that almost all case study countries consider EE investments as key for economic recovery due to covid-19, robust DS tools including EU taxonomy which appears as a more specific action that provides concrete guidance for financial market participants, investors, large companies, and national regulators. To this end, Triple-A Standardised Tools have great potential on assisting towards reliable EE investments in order to provide a twofold advantage, not only for investors but governmental targets in environment and economy as well.

7. Conclusions

Indeed, during the second quarter of 2020 several economic activities have slowed down in European countries, including the EE sector. In the meanwhile, some of the funding for domestic EE projects upon EU approval has been redirected to cover economic impact of covid-19. Thus, a very important task that arisen for European countries with regards to the energy sector, is to ensure that the EE will assist in countering this recession, through the financing support of targeted and attractive new EE investments. However, the knowledge gap on the way project developers implement their projects, especially, at the early stage of project identification, as well as the lack of trust from the financiers in such investments acts as a barrier to including EE projects in the investment portfolio.

As analysed in the present study, the EE sector has emerged as very promising towards addressing the impacts of covid-19. The scope, however, is to ensure that the EE investments will meet their commitments as pandemic effects have increase economic volatility.

From the case study countries analysis that conducted and based on feedback received from the regional authorities and municipalities through a targeted stakeholder engagement strategy, it is clear that EE investments are considered as a high priority towards an economic recovery and countries are planning EE projects even now, during this period impacted by the pandemic. Promoting innovation to drive energy transition response in energy sector enhancement during pandemic crisis is the key drivers for the case-study countries regardless the number of confirmed cases.

To this end and in order to implement the energy recovery plans, financial resources are necessary and will be one of the main challenges during the after covid-19 era. History shows that large-scale crises force us to significantly rethink and create opportunities to rebuild better. However, appropriate and reliable tools are required for that purposes.

To this end, DS tools could be proved as key role players for EE sector. However, action should not include only technical approach and methodologies, but policies should be taken into consideration so as a common language to be used in order to connect the physical currency of energy transition and environmental targets to economic and financial ones. The Triple-A project, as a more integrated approach to identify sustainable, de-risked and attractive EE investments by having incorporated EU taxonomy eligibility criteria, could play a crucial role by advancing EE investments and turning pandemic crisis consequences into opportunities, not only for sustainable growth, but for the energy transition as well.

As next step, Triple-A tools will be tested in the case study countries, so as to assess results for EE investments and evaluate the importance of EU taxonomy to fill the gap their bankability. In that way, lack of evidence on the performance will be eliminated. On top of that is the aggregation of EE investment in a marketplace which will accelerate their
bankability. The increasing availability of more granular high quality of data in terms of performance may increase the EE investment implementation and more and more investors will be attracted.

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