

Written on 23 October 2025



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Economic outlook

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The collection “IFPEN Economic Papers” – formerly « *Les Cahiers de l'Économie* », since 1990 – aims to present work carried out at IFP Energies nouvelles and **IFP School** dealing with economics, finance or management of the energy transition.



Optimal Deployment of Engineered Carbon Dioxide Removal (BECCS &

DACS) in the Northsea Region
N° 163 – October 2025 [RESEARCH]
Romain Presty

This study focuses on two engineered options: Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Carbon Capture and Storage (DACCS), to determine least-cost deployment strategies across nine European countries bordering the North Sea from 2025 to 2050.

 [Read the article](#) / [Download \(PDF - 6.5 Mo\)](#) 



Explaining Green Excess Returns in the Stock Market: A Five-Factor Model

Approach

N° 162 – February 2025 [RESEARCH]

Wang Heda, [Arash Farnoosh](#) and [Tang Jingyea](#)

The study examines stocks in the new energy, energy-saving, and environmental protection industries to explain green excess returns in the case of Chinese stock market. The green four-factor model is constructed by introducing the green factor based on the Fama-French three-factor model. Empirical results show that this model better explains the risk-return of green concept stocks compared to the three-factor model by verifying the existence of green excess returns, though its explanatory power still needs improvement. Therefore, the study uses stock turnover rate and the firm's return on investment as indicators of the sentiment factor and the efficiency factor, respectively, from the perspectives of green investment sentiment in behavioral finance and positive externalities in microeconomics. The green five-factor model is then constructed by introducing the green sentiment factor and green efficiency factor. Empirical results show that the green five-factor model better interprets the risk-return of green concept stocks compared to the three-factor model and the green four-factor model, with the green sentiment factor and green efficiency factor having a significant positive effect on the return of green concept stocks.

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The Performance of China Green Funds around the COVID-19: A

Comparative Study with Black Funds and Conventional Funds

N° 161 – December 2024 [RESEARCH]

Wang Heda, Arash Farnoosh and Wang Zhen

The analysis covers 102 green funds, 64 black funds, and 434 conventional funds in China, comparing their performance over 93 sample intervals from November 2015 to July 2023. The performance of green and black funds is significantly higher than that of conventional funds over the entire sample period, primarily due to the greater impact of COVID-19 on the industries in which conventional funds invest. Notably, green funds outperform black funds. When dividing the sample period at the onset of COVID-19, it is found that conventional funds generally outperform green and black funds before the pandemic, while green and black funds significantly outperform conventional funds during COVID-19. After COVID-19, as the state promotes economic recovery, conventional funds again outperform green and black funds. Overall, the performance of green funds gradually improves over time, with increased investment in large-cap and growth stocks.

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The rise and fall of Neoliberalism: an ecological and regulationist analysis

of France (1960-2022)

N° 160 – June 2024 [RESEARCH]

Alban Pellegris and Victor Court

In this article, we enrich Regulation Theory with metrics from ecological economics: thermodynamic efficiency, exosomatic metabolic rate and the weight of energy expenditure relative to GDP. Then, we use this framework to analyze French capitalism since 1960.

 [Read the article](#) / [Download \(PDF - 3.4 Mo\)](#) 



Decarbonizing China's iron and steel industry: policy incentives and

technological paths

N° 159 – April 2024 [RESEARCH]

Yang Liu, Yuchen Zhang, Xiaoli Zhao, Rongda Zhang and [Arash Farnoosh](#)

This article develops a mixed integer programming model to explore how the Chinese iron and steel industry can efficiently manage the simultaneous phasing out of blast furnaces and promotion of advanced steelmaking technologies.

 [Read the article](#) / [Download \(PDF - 4 Mo\)](#) 



Synergistic effect analysis of policy instruments in environmental

governance considering the social context

N° 158 – March 2024 [RESEARCH]

Yang Liu, Yuchen Zhang, [Arash Farnoosh](#), Ruoran Ma and Xiaoli Zhao

This article assesses the synergistic effects between policy instrument combinations and social contexts in the field of environmental governance in 29 province-level regions in China, from 2006 to 2018.

 [Read the article](#) / [Download \(PDF - 6 Mo\)](#) 



ORION - Oil and renewables refining industry optimization and synergies

N° 157 – February 2024 [RESEARCH]

Clarissa Bergman-Fonte, Fernanda P. D. C. Guedes, Frédéric Lantz, Pedro R. R. Rochedo and Alexandre Szklo.

This article introduces ORION, a GAMS-based Mixed Integer Linear Programming model designed to optimize the refining sector. ORION addresses not only conventional refinery operations, but also focuses on novel opportunities for integrating the sector into a context of carbon intensity reduction.



[Read the article / Download \(PDF - 4.1 Mo\)](#)



Decarbonizing aviation with sustainable aviation fuels: myths and realities

of the roadmaps to net zero by 2050

N° 156 – October 2023 [RESEARCH]

Paul Bardon, Olivier Massol

This paper analyzes the factors influencing present and future sustainable aviation fuels (SAF) market availability – namely resources, technologies, and costs – and attempts to assess the credibility of current SAF development scenarios.



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HERA – Hydrogen economics and infrastructure optimization model

N° 155 – June 2023 [RESEARCH]

Gabriela Nascimento da Silva, Frédéric Lantz, Pedro Rochedo, Alexandre Szklo

The article develops an optimization model of the whole hydrogen value chain, from the H₂ production (including water electrolysis and steam reform with and without carbon capture) up to the H₂ delivery to consumers via road transportation or pipelines.

 [Read the article / Download \(PDF - 2.1 Mo\)](#) 





EROI minimum et croissance économique

N° 154 – Mai 2023 [RECHERCHE]

Victor Court, Floriane Fizaine

Après avoir rappelé les concepts d'énergie nette et d'EROI, simples et intuitifs en apparence, nous détaillerons les raisons pour lesquelles l'utilisation de ces notions est difficile en pratique. Nous reviendrons ensuite sur les résultats les plus importants en ce qui concerne le EROI minimum requis pour observer une croissance de l'activité dans une économie moderne. Nous discuterons enfin des notions de croissance, de prospérité et de leurs liens avec l'EROI et la sobriété.

 [Read the article / Download \(PDF in French - 1 Mo\)](#) 



Modeling CO₂ pipeline systems: An analytical lens for CCS regulation

N° 153 – April 2023 [RESEARCH]

Adrien Nicolle, Diego Cedrerros, Olivier Massol, Emma Jagu Schippers

Carbon Capture and Storage (CCS) is regularly depicted as a crucial technology to reduce the social cost of achieving carbon neutrality. However, its deployment critically depends on the installation of CO₂ infrastructures. As the regulatory procedures governing their provision are yet to be clarified, the purpose of this paper is to assess the social and environmental impacts of such regulations. We show how the engineering equations of a CO₂ pipeline implicitly define a Cobb-Douglas production function.

[Read the article / Download \(PDF - 1.1 Mo\)](#) 



Is Power-to-Gas always beneficial? The implications of ownership

structure

N° 152 – February 2023 [RESEARCH]

Camille Megy, Olivier Massol

Power-to-gas (PtG), a technology that converts electricity into hydrogen, is expected to become a core component of future low-carbon energy systems. While its economics and performance as a sector coupling technique have been well studied in the context of perfectly competitive energy markets, the distortions caused by the presence of large strategic players with a multi-market presence have received little attention. In this paper, we examine them by specifying a partial equilibrium model that provides a stylized representation of the interactions among the natural gas, electricity, and hydrogen markets.

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2022



[European Economic impacts of cutting energy imports from Russia: a](#)

[computable general equilibrium analysis](#)

N° 151 – November 2022 [RESEARCH]

Sigit Perdana, Marc Vielle, Maxime Schenckery

The recent economic sanctions against Russia can jeopardize the sustainability of the European Union's (EU) energy supply. Despite the EU's strong commitment to stringent abatement targets, fossil fuels still play a significant role in the EU energy policy. Furthermore, high dependency on Russian energy supplies underlines the vulnerability of the EU energy security. Using a global computable general equilibrium model, we prove that the current EU embargo on coal and oil imported from Russia will have adverse supply effects, substantially increasing energy prices and welfare costs for the EU resident.



[Read the article / Download \(PDF - 6.4 Mo\)](#) 



Non-linear distance decay effects of clean energy facilities in housing

rental and sale markets: Evidence from hydrogen refueling stations

N° 150 – June 2022 [RESEARCH]

Shuya Wu, Arash Farnoosh, Yingdan Mei

While promoting green and low-carbon transition, clean energy facilities also have externalities, which may lead to opposition and economic losses. There is evidence that the impact of facilities decreases with distance, but existing research make strict assumption on its functional form. In this research work we explore the non-linear relationship between housing transaction prices and distances to the nearest facility without predefined functions combined with spatial smoothing in the hedonic pricing model by taking China as a case-study.

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Certificats d'Economies d'Énergie : ne pas oublier les fondamentaux !

N° 149 - May 2022 [ANALYSIS]

Benoit Ferres, Jacques Millery, Maxime Schenckery

Les Certificats d'Economies d'Énergie, CEE font régulièrement l'objet de nombreux débats. Nous proposons ici un retour aux fondamentaux de l'Article 7 européen pour comprendre la logique des attentes qui sont à leur origine, et ainsi mieux cerner l'ensemble des dimensions à l'aune desquelles leur impact devrait être évalué.

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Electricity Distribution Systems in Europe: An Overview of Contemporary

Regulatory Challenges

N° 148 - April 2022 [ANALYSIS]

Pedro H. Perico E Santos, Olivier Massol

In Europe, a significant adaptation of the existing power distribution sector is necessary to support the transition toward low-carbon energy systems and facilitate the massive deployment of low-carbon distributed power technologies. This report first examines the current organization of that industry and highlights the country-specific and diverse nature of the industry structures and the institutional organizations governing the distribution sector.

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Unlocking CO₂ infrastructure deployment: the impact of carbon removal

accounting

N° 147 – February 2022 [RESEARCH]

Emma Jagu, Olivier Massol

This paper examines the interactions between carbon removal accounting (which determines financial incentives for BECCS) and optimal CO₂ infrastructure deployment by asking how certification affects the feasibility of BECCS projects.

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The impact of Electric Vehicle fleets on the European electricity markets:

evidences from the German passenger car fleet and power generation sector
 N° 146 – January 2022 [RESEARCH]

Maria Juliana Suarez Forero, **Frédéric Lantz**, Pierre Nicolas, Patrice Geoffron

The rapidly increasing participation of renewable energies (REn) into the electric mix, clearly traces the trends for the decarbonization goals in the European Union. Under the priority sale conditions established by governments, the commercialization of REn plays an important role in the consolidation of market prices, which are on a decreasing trend with large fluctuations that reduce the profit in the power sector and therefore, the interest of potential investors.



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2021



A Game-theory Analysis of Electric Vehicle Adoption in Beijing under

License Plate Control Policy

N° 145 – September 2021

Lijing Zhu, Jingzhou Wang, **Arash Farnoosh**, Xunzhang Pan

This paper proposes a two-level Stackelberg game which portrays the interaction between vehicle applicants and the government to quantify the optimal EV license plates under the LPC policy in Beijing.

[Read the article](#) / [Download \(PDF - 1.6 Mo\)](#) 



[Does something change in the oil market with the COVID-19 crisis?](#)

N° 144 – July 2021

Dan Zhang, Frédéric Lantz, Arash Farnoosh

This paper examines the price discovery of three international crude oil futures markets (WTI, Brent, INE) before and after the outbreak of the COVID-19 with the application of information share and component share model.

[Read the article](#) / [Download \(PDF -1.2 Mo\)](#) 



[Short-term electricity price forecasting models comparative analysis:](#)

Machine Learning vs. Econometrics

N° 143 – May 2021

Antoine Ferre, Guillaume de Certaines, Jérôme Cazelles, Tancrede Cohet, Arash Farnoosh, Frédéric Lantz

This paper gives an overview of several models applied to forecast the day-ahead prices of the German electricity market between 2014 and 2015 using hourly wind and solar productions as well as load.

 [Read the article / Download \(PDF - 5.8 Mo\)](#) 



Estimating discrete choice experiments: theoretical fundamentals

N°142 – April 2021

Benoît Chèze, Charles Collet, and Anthony Paris

This working paper overviews theoretical foundations and estimators derived from econometric models used to analyze stated choices proposed in Discrete Choice Experiment (DCE) surveys.

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Cinquième période à venir : les Certificats d'Economies d'Energie,

catalyseurs du couple Reprise / Transition Ecologique ?

N°141 - March 2021 [STUDY & SYNTHESIS]

Maxime Schenckery, Jacques Millery

Les travaux sur la forme que devra prendre la 5^{ème} période de CEE ont continué, suscitant bien des débats, et aboutissant à une première série de propositions rendue publique début février 2021.



Trajectory Based Robust Optimization Applied to the Case of Electricity

Facilities Investment with Significant Penetration of Renewables

N°140 – February 2021

Pierre Cayet, Arash Farnoosh

As large scale penetration of renewables into electric systems requires increasing flexibility from dispatchable production units, the electricity mix must be designed in order to address brutal variations of residual demand. Inspired from the philosophy of Distributionally Robust Optimization (DRO), we propose a trajectory ambiguity set including residual demand trajectories verifying both support and variability criterion using ambiguous quantile information.



Quantifying virtual water scarcity risk transfers of energy system in China

N°139 – January 2021

Xuebing Yao, Xu Tang, Arash Farnoosh, Cuiyang Feng

Using multi-regional input-output analysis, this study estimates the virtual flows and virtual water scarcity risk transfers driven by interprovincial energy consumption in China. Results could provide reference value for policymakers to develop new energy strategies and manage water resources sustainably.

2020



How are day-ahead prices informative for predicting the next day's

consumption of natural gas?

N°138 – December 2020

Arthur Thomas, Olivier Massol, Benoît Sévi

Using data from France, this paper investigates, for the first time, whether the next day's consumption of natural gas can be accurately forecast using a simple model that solely incorporates the information contained in day-ahead market data.

 [Read the article / Download \(PDF - 1.8 Mo\)](#) 



Dynamics of biofuel prices on the European market

N°137 – November 2020

Francis Declerck, Jean-Pierre Indjehagopian, Frédéric Lantz

This paper aims at explaining the major drivers of biodiesel market prices by examining agricultural resource prices and gasoil prices for automotive fuels in the context of the EU environmental policy.

 [Read the article / Download \(PDF - 4 Mo\)](#) 



Certificats : marier reprise économique et transition écologique

N°136 - September 2020 [STUDY & SYNTHESIS]

Maxime Schenckery, Jacques Millery

Dans une économie durement touchée par la COVID 19, comment remettre en fonction des acteurs de base de l'économie sur notre territoire à travers des activités porteuses de sens liées à la transition énergétique, dans un contexte de crise où en plus un prix du pétrole bas n'encourage pas cette transition ?

L'utilisation du mécanisme des certificats permet-il de résoudre ce paradoxe, en mariant support à la relance économique et transition énergétique ?

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Building infrastructures for Fossil- and Bio-energy with Carbon Capture and

Storage: insights from a cooperative game-theoretic perspective

N°135 - August 2020

Emma Jagu, Olivier Massol

This paper examines the deployment of a shared CO₂ transportation infrastructure needed to support the combined emergence of bio-energy with carbon capture and storage (BECCS) and fossil energy with carbon capture and storage (CCS).

 [Read the article / Download \(PDF - 2.5 Mo\)](#) 



Energy, Knowledge, and Demo-Economic Development in the Long Run

N°134 – May 2020

Emmanuel Bovari, Victor Court

In this article we provide a quantitative analysis of the role of energy in long-term growth, accounting for the interaction between human capital accumulation and technological change. To do so, we design a unified growth model featuring fertility and educational choices, energy resources extraction, directed technical change, and endogenous general purpose technologies diffusion.

 [Read the article / Download \(PDF – 3.5 Mo\)](#) 



A systematic review of the energy and climate impacts of teleworking

N°133 – March 2020

Andrew Hook, Victor Court, Benjamin Sovacool, Steve Sorrell

This review assesses how changes in working practices are associated with different forms of teleworking, including the use of different ICTs, various commuting/travel options, and different working spaces such as offices, cafes, libraries, and homes.

 [Read the article / Download \(PDF – 1.8 Mo\)](#) 



What can be learned from the free destination option in the LNG imbroglio?

N°132 – January 2020

Amina Baba, Anna Creti, Olivier Massol

This article examines the profitability of flexible routing by LNG cargoes for a single supplier taking into account uncertainty in the medium-term dynamics of gas markets. Results portend a substantial source of profit for the industry and reveal future movements of vessels.



[Read the article / Download \(PDF – 3 Mo\)](#)



2019



A Representation of the World Population Dynamics for Integrated

Assessments Models

N° 131 – November 2019

Victor Court, Florent Mclsaac

Using the gross world product (GWP) as the only exogenous input variable, we design a model able to accurately reproduce the global population dynamics over the period 1950–2015. We then add to our model an excess mortality function associated with climate change.



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Rate-of-return regulation to unlock natural gas pipeline deployment

N° 130 – September 2019

Florian Perrotton, [Olivier Massol](#)

Focusing on the situation in Mozambique, we examine whether the adoption of rate-of-return (RoR) regulation can reconcile the public authorities' ambition for the construction of a large national pipeline system and the preference of foreign private investors for smaller infrastructure that are solely intended to supply a few creditworthy industrial sites.

[Read the article / Download \(PDF - 5.1 Mo\)](#) 



Copper at the Crossroads

N° 129 – July 2019

Clément Bonnet, [Gondia Seck](#), [Emmanuel Hache](#), [Marine Simoën](#), [Samuel Carcanague](#)

The aim of this article is to assess the impact of copper availability on the energy transition and to answer the question whether copper could become critical to the power and the transport sectors due to the high copper content of low-carbon technologies compared to conventional technologies.

[Read the article / Download \(PDF - 7.7 Mo\)](#) 



Understanding farmers' reluctance to reduce pesticide use: A choice

experiment

N° 128 – June 2019

Benoît Chèze, Maïa David, Vincent Martinet

This article analyzes conventional farmers' willingness to reduce their use of synthetic pesticides. To do so, a discrete choice experiment was design to include the risk of large production losses due to pests.

[Read the article / Download \(PDF - 5 Mo\)](#) 



Economic Assessment of the Development of CO₂ Direct Reduction

Technologies in Long-term Climate Strategies of the Gulf Countries

N° 127 – May 2019

Frédéric Barbonneau, Ahmed Badran, Maroua Benlahrech, Alain Haurie, Maxime Schenckery, Marc Vielle

In this paper, we explore the long-term options offered to GCC countries by Carbon Capture and Storage (CCS) and Carbon Dioxide Removal (CDR) technologies in the negotiations for a fair burden sharing of Paris agreement objectives.

[Read the article / Download \(PDF - 2.5 Mo\)](#) 



Some Geopolitical Issues of the Energy Transition

N° 126 – March 2019 [STUDY & SYNTHESIS]

Emmanuel Hache, Samuel Carcanague, Clément Bonnet, Gondia Seck, Marine Simoën

This article is a summary in English of the Policy Paper published in January 2019 under the title “Vers une géopolitique de l'énergie plus complexe ? Une analyse prospective tridimensionnelle de la transition énergétique”, Policy Research Working Paper, Projet GENERATE, IRIS – IFP Energies nouvelles – ANR.

[Read the article / Download \(PDF - 7.6 Mo\)](#) 



On the CO₂ emissions determinants of the EU ETS Phases I and II

N° 125 – February 2019

Benoît Chèze, Julien Chevalier, Nicolas Berghmans, Emilie Alberola

This article studies ex-post the CO₂ emissions determinants during 2005-2012 by resorting to an original database merging the European Union Transaction Log (EUTL) with the World Electric Power Plants (WEPP) database maintained by Platts.

[Read the article / Download \(PDF - 3.9 Mo\)](#) 

2019



The Nexus Between Climate Negotiations and Low-Carbon Innovation :A

Geopolitics of Renewable Energy Patents

N° 124 – December 2018

Clément Bonnet, Samuel Carcanague, **Gondia Seck**, Emmanuel Hache, Marine Simoën

Intellectual property is a central issue in the climate negotiations. On the one hand, it shapes and encourages innovation in low-carbon technologies. On the other hand, it reduces access to these technologies by giving patent holders market power. We analyze the interactions between climate negotiations and the acquisition of patents on renewable energy technologies.

[Read the article / Download \(PDF - 4.2 Mo\)](#) 



Analyzing the Dynamic Impact of Electricity Futures on Revenue and

Risk of Renewable Energy in China

N° 123 – October 2018

Yue Zhang, **Arash Farnoosh**

Although the electricity market in China has gone through several reforms, there is not yet a competitive spot or derivative market. This article proposes a model that estimates the risk premium and simulates the future prices in China's market.

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Climate-energy-water nexus in Brazilian oil refineries

N° 122 – September 2018

Fernanda Guedes, Alexandre Szklo, Pedro Rochedo, [Frédéric Lantz](#), Leticia Magalar, Eveline Maria, Vázquez Arroyo

By simulating two parametric models, one for all Brazilian refineries, and the other locally detailing the water balance of the country's largest refinery, this study aimed to quantify the impacts of CO₂ mitigation options on the water use of oil refineries.

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Policy measures targeting a more integrated gas market

N° 121 – June 2018

Ekaterina Dukhanina, [Olivier Massol](#), François Lévêque

Based on a French case study, this article answers the question whether a merger of gas trading zones contributes to the development of liquid trading activities through a more efficient allocation and pricing of natural gas and an increased competition.

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Is there a market value for energy performance in a local private housing

market?

N° 120 – April 2018

Déborah Leboullenger, Frédéric Lantz, Catherine Baumont

Using frontier functions instead of the customary hedonistic approach, this article aims to find evidence of a “green value” in a local housing market using notarial data on a small urban area in France.

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Demand-pull instruments and the development of wind power in Europe:

a counterfactual analysis

N° 119 – March 2018

Clément Bonnet, Marc Baudry

This paper examines the effect of demand-pull policies on the diffusion of onshore wind power technology in six European countries: Denmark, France, Germany, Italy, Portugal and Spain.

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GIS-Based Multi-Objective Particle Swarm Optimization of Charging

Station for Electric Vehicles – Taking a District in Beijing as an Example

N° 118 – February 2018

Yue Zhang, Arash Farnoosh, Qi Zhang, Siyuan Chen

The rapid development of electric vehicles can greatly alleviate the environmental problems and energy tension. However, the lack of public supporting facilities has become the biggest problem hinders its development.



[Read the article / Download \(PDF - 2.8 Mo\)](#)



2017



Spatial integration of natural gas markets: A literature review

N° 117 – November 2017

Ekaterina Dukhanina, Olivier Massol

The purpose of this paper is to clarify the definition of an integrated market and to provide a commented overview of the different empirical methodologies that have been proposed to assess the degree of spatial integration of natural gas markets.

[Read the article](#) / [Download \(PDF - 3 Mo\)](#) 



Long-term endogenous economic growth and energy transitions

N° 116 – September 2017

Victor Court, Pierre-André Jouvét, Frédéric Lantz

This article build a bridge between the endogenous economic growth theory, the biophysical economics perspective, and the past and future transitions between renewable and nonrenewable energy forms that economies have had to and will have to accomplish.

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The technology and cost structure of a natural gas pipeline

N° 115 – July 2017

Florian Perrotton, Olivier Massol

This note details a complete microeconomic characterization of the physical relationships between input use and the level of output of a simple point-to-point gas pipeline system and uses it to contribute to the public policy discussions pertaining to the economic regulation of natural gas pipelines.

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Impact of variable renewable production on electricity prices in

Germany: a Markov Switching model

N° 114 – May 2017

Cyril Martin de Lagarde, Frédéric Lantz

This paper aims at assessing the impact of renewable energy sources (RES) production on electricity spot prices. To do so, we use a two-regime Markov Switching (MS) model, that enables to disentangle the so-called “merit-order effect” due to wind and solar photovoltaic productions (used in relative share of the electricity demand), depending on the price being high or low.

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Long-term estimates of the energy-return-on-investment (EROI) of coal,

oil, and gas global productions

N° 113 – March 2017

Victor Court, Florian Fizaine

In this study, we use a price-based methodology to assess the global energy-return-on-investment (EROI) of coal, oil, and gas, from the beginning of their reported production (respectively 1800, 1860, and 1890) to 2012.

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Market power and spatial arbitrage between interconnected gas hubs

N° 112 – January 2017

Olivier Massol, Albert Banal-Estañol

This paper examines the performance of the spatial arbitrages carried out between two regional markets for wholesale natural gas linked by a pipeline system. We use the case of the “Interconnector” pipeline linking Belgium and the UK as an application.


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