Policy Options for Promoting Green Technologies in the Arab Region

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Abbreviations

AAAA	Addis Ababa Agenda for Action
AIDMO	Arab Industrial Development and Mining Organization
CBD	Convention on biological Diversity
CDM	Clean Development Mechanism
COP	Conference of Parties
EE	Energy efficiency
EGS	Environmental Goods and Service
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCWA	Economic and Social Commission for Western Asia
ETC	ESCWA Technology Center
EU	European Union
EU ETS	European Union Emission Trading Scheme
FAO	Food and Agriculture Organization of the United Nations
FiT	Feed-in-Tariffs
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product GG Green Growth
GHG	Greenhouse Gases
GEF	Global Environment Facility
HFCVs	Hydrogen Fuel-Cell Vehicles
ICT	Information and communications technology
IRENA	International Renewable Energy Agency
LAS	League of Arab States
LEED	Leadership in Energy and Environmental Design
ILO	International Labor Organization
IECI	Intensive Energy Consuming Industries
IT	Information technologies
KSA	Kingdom of Saudi Arabia
MENA	Middle East and North Africa
MFI	Microfinance Institution
MW	Megawatt
OECD	Organization for Economic Cooperation and Development
R&D	Research and Development
REEF	Renewable Energy Efficiency Fund
SDGs	Sustainable Development Goals
SME	Small and Medium Enterprises
STI	Science Technology and Innovation
PES	Payment for Ecosystem Services
UAE	United Arab Emirates
UN	United Nations
UNDP	United Nations Development Programme
UN DESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WBC	world Business Council

ABSTRACT

As the world embarks on implementing the 2030 Agenda for sustainable development, the Arab region lags behind on the road towards sustainable development and inclusive growth. The region faces considerable challenges in generating and adopting green technologies: it faces, difficulties absorbing or diffusing such innovations, as well as facing socioeconomic, and political impediments.

Governments can encourage businesses to adopt green technologies by applying economic policy instruments, providing access to financial mechanisms, supporting research and development, and improving the overall environment of doing business. If the Arab region aims to improve competitiveness, enhance environmental performance, and ensure citizens' prosperity through a more sustainable future, it needs to adopt and implement economic policy instruments and mechanisms providing a stable and long-term regulatory framework that allows for sound business decisions and attracts investors.

This report makes the case for economic policies as an important tool to promote green technology and achieve sustainable development goals. It provides an overview of economic policy options, draws on examples from the Arab region and beyond.

خيارات سياسات التكنولوجيا الخضراء في المنطقة العربية

الملخص التنفيذي

التكنولوجيا الخضراء في المنطقة العربية

الصناعة العربية المحلية تكافح من أجل تبني تكنولوجيا جديدة، والتنافس مع نظرائها من اقتصادات الأسواق الناشئة. حيث لا تزال المنطقة مستخدما للتكنولوجيا، بدلا من أن تكون منتجا لها. ومع أن عدم الاستقرار السياسي يشكل تحديا لدول المنطقة العربية من المضي قدما، فإن المنطقة مضطرة إلى العمل من أجل تحقيق نمو اقتصادي أكثر كفاءة، وصديق للبيئة، ويتسم بالشمول الاجتماعي، ويضمن تحقيق خطة التنمية المستدامة لعام ٢٠٣٠.

لا تزال العديد من الدول في المنطقة العربية تطبق ممارسات غير مستدامة في إدارة الموارد الطبيعية. كما أن سياسة الدعم الحالي للوقود التي تشمل الجميع وغير محددة الاستهداف، تؤدي الى الحد من استخدام وسائل النقل العام، وصعوبة تبني مصادر الطاقة المتجددة. كذلك يجري الهدر في استهلاك المياه؛ بسبب النقص في قياس الكميات المستهلكة، وصعوبات في تطبيق التشريعات في بعض الدول. ولا يزال قطاع النفايات يفتقر إلى الادارة الجيدة بشكل كبير على الرغم من توفر التكنولوجيا على نطاق واسع عالميا، مما يؤثر سلبا على صحة الانسان والبيئة.

وتستثمر الشركات في التكنولوجيا الخضراء لأسباب عديدة، لكن ذلك يحصل بشكل رئيس ضمن إطار استعدادها للالتزام بالسياسات الجديدة، ولجني ثمار البيئة المواتية كالإعفاءات الضريبية مثلا، واستجابة لزيادة وعي المستهلك وتغير متطلباته. وعلى الصعيد العالمي، فقد تبنت الدول الرائدة في مجال التكنولوجيا الخضراء مجموعة من السياسات التي تدعم اعتماد هذه التكنولوجيات، وقامت بتوفير بيئة ملائمة لأصحاب الاعمال، مما أظهر الدور الملتزم والقيادي الحكومي نحو تحقيق الاستدامة. وعليه فإن هذا التقرير يهدف إلى الإجابة على السؤال المتعلق بكيفية قيام الحكومات في المنطقة العربية بجذب الاستثمارات ودفع رؤوس الاموال إلى الاستثمار في التكنولوجيا الخضراء.

ولا بد من مراجعة السياسات الاقتصادية والمالية، من أجل وضع إطار مستقر واستراتيجيات طويلة الأجل للإدارة البيئية، مع تحديد للمسؤوليات والولايات السياسية والتشريعية الواضحة. وعلاوة على ذلك، فإن تلك السياسات تحتاج إلى التطرق الى قضايا هامة مثل؛ بناء القدرات، ونشر المعرفة، والإدارة الكفؤة للأموال العامة.

السياسات الاقتصادية لتشجيع التكنولوجيا الخضراء

السياسات المالية

تعي الحكومات في المنطقة العربية بشكل متزايد مدى الحاجة إلى إصلاح نظام دعم السلع، حيث أن هناك توافق متنامي في الآراء على أن دعم الطاقة مثلا، ينبغي أن يركز على توسيع فرص الحصول على التكنولوجيا، والوقود الأنظف، وزيادة الكفاءة في الاستخدام بدلا من تشجيع الاستهلاك. وفي هذا الصدد، بدأت جميع الدول في مجلس التعاون الخليجي، بالإضافة الى الأردن، ومصر، والجزائر، وتونس، في خفض الدعم الضار بيئيا، والتأكد من أن سياسات الدعم الجديدة تحمي شريحة الدخل المنخفض في المجتمع.

فالدول العربية لا تطبق **الضرائب البيئية** عادة. بينما تعتبر أنظمة الإعفاء الضريبي على الدخل أكثر شيوعا، بخاصة بالنسبة للمنشآت الملتزمة بحماية البيئة عن طريق تركيب تكنولوجيا صديقة للبيئة، أو تبنى كفاءة استخدام الطاقة، أو الشركات التي تقوم بمعالجة النفايات.[١] ومع ذلك، تمثل الضرائب حافزا للحد من التلوث بخاصة إذا كان المعدل الضريبي ثابتا، ومحددا على المستوى الصحيح، بحيث يسمح لمن يلوث باتخاذ قرار ملائم بشأن طرق المعالجة والحد من التلوث.[٢]

وتطبق **التعرفة** على خدمات المياه والصرف الصحي في العديد من الدول في المنطقة العربية، وتتخذ غالبا شكل قيمة ثابتة أو متغيرة حسب استخدام المياه، أو مزيج من الاثنين معا. ومع ذلك، فإن تعرفة مياه الشرب في معظم الدول العربية لا تعطي حافزا للمستهلك لتوفير المياه. وكذلك يمكن استخدام **حقوق المياه القابلة للتداول والتجارة** محليا؛ حيث تستخدم **الأفلاج** في سلطنة عمان لإدارة الموارد الطبيعية المحدودة بين مستخدميها. علما بأن تطبيقها يتطلب خلفية إدارية وتنظيمية متينة، وتوفر البيانات، ووجود مستوى عال من الشفافية لضمان الالتزام وتنفيذ جميع المعاملات.

كما أن العديد من الدول في المنطقة العربية لديها قوانين تتعلق **بالمشتريات العامة الخضراء** لضمان الاستدامة، إلا أن هذه القوانين لا تطبق على نطاق واسع. فالقوة الشرائية الحكومية تستطيع أن تؤثر بقوة على عملية الطلب على السلع والخدمات الصديقة للبيئة من خلال وضع قواعد للمشتريات الخضراء الحكومية، اضافة الى الاستثمار في مشاريع من شأنها دفع العرض والابتكار في مثل هذه القطاعات التكنولوجية. ويعتبر الاستثمار الحكومي في مجال **البحث والتطوير** وسيلة فعالة لتحفيز الابتكار وتكييف التكنولوجيا الخضراء لتتلاءم مع السياق المحلي. وعليه، فإن الحكومات العربية مدعوة للقيام برفع سوية وكفاية برامج التعليم والتدريب لدعم البحث والتطوير من أجل الابتكار الأخضر، ولضمان تلبية حاجات السوق والخريجين، ومنع هجرة الأدمغة. وقد ساعدت **الشراكات بين القطاعين العام والخاص** في المنطقة العربية على إيجاد مصادر بديلة للتمويل وسمحت بزيادة تدفق المساعدات الفنية إليها. إلا أنه من المكن للمنافسة المحدودة أن تعرقل عملية تقليل التكاليف.

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[١] الاسكوا(٢٠١١)،التمويل الأخضر للمنطقة العربية،ورقة تمهيدية ضمن سلسلة الاجتماعات التحضيرية الاقليمية لريو+٢٠ حول السياسات الاقتصادية الداعمة للتحول نحو اقتصاد أخضر في المنطقة العربية.http://css.escwa.org.lb/SDPD/1610/sdpd11_en.pdf

[٢] Hesse, D.M.) (٢٠١٣)، تعزيز الابتكارات التكنولوجية الخضراء:دور السياسات البيئية،UNECE.
https://www.unece.org/fileadmin/DAM/SPECA/documents/kdb/2013/Seminar_Kazakhstan/3_Hesse.pdf

حيث ينبغي للحكومات أن تطور عمليات صنع القرار بشكل واضح لضمان شمول جميع أصحاب المصلحة المهتمين.

أدوات التمويل

حيث تتطلب التكنولوجيا الخضراء توفر فرص الاستثمار، ونقل التكنولوجيا أو تطويرها أو توطينها، إلى جانب اقترانها ببناء القدرات. ومع أن المنطقة العربية تواجه محدودية الوصول إلى رأس المال؛ إلا أنه يمكن للحكومات أن تزيد من توفير فرص التمويل من خلال جذب الاستثمار وتوفير بيئة ملائمة له.

وتزدهر في معظم دول المنطقة **حاضنات الأعمال و"المسرعات"**؛ إذ تقوم بتحفيز الطاقات الشابة لتطوير أفكارها ومشاريعها المبتكرة. وتقدم الدعم المالي إلى جانب خدمات الحضانة والتدريب. وفي المرحلة التالية؛ تقدم **شركات رؤوس الأموال الاستثمارية** (الخضراء) للرياديين مساعدة رأسمالية تأسيسية صغيرة من رجال الأعمال، كما تقدم رأس المال اللازم لتنمية الأعمال القائمة. وتزداد هذه الشركات باطراد في المنطقة العربية لتصل إلى أكثر من ١٠٠ شركة، حيث تلعب دورا هاما في تحفيز الابتكار.

ولا يزال **قطاع التمويل الميكروي** صغيرا، ويمكن أن يعزى الانتشار المحدود لهذا النوع من التمويل إلى عدم وجود تشريعات تدعم النمو القوي لمؤسسات التمويل الميكروية، والى عدم توفر البنية التحتية المالية المطورة والمواتية، ومحدودية المعرفة المالية بين المستفيدين المحتملين.[٣]

وقد شهدت مؤخرا **قروض البنوك المركزية، وضمانات القروض، والقروض المضمونة بالأسهم** مزيدا من التطور في الأسواق المالية العربية. حيث تقدم البنوك المركزية، ولا سيما في لبنان والأردن، قروضا منخفضة الفائدة وقروضا طويلة الأجل أو مدعومة، للمشاريع الرفيقة بالبيئة بما في ذلك مشروعات الطاقة المتجددة، وإدارة النفايات، ومعالجة المياه، بالإضافة الى البنية التحتية الخضراء للأعمال التجارية. ، كما ظهرت الصكوك الخضراء كحل استثماري في المنطقة العربية؛ حيث جذبت انتباه المستثمرين من مجلس التعاون الخليجي للاستثمار في مشاريع طموحة؛ كالطاقة المتجددة والبنية التحتية.

خلق بيئة مواتية للتكنولوجيا الخضراء

ففي حين أن عددا من الدول العربية قد وضعت قوانين لحماية البيئة، إلا أن تنفيذ تلك القوانين لا يزال يعاني من عدم كفاية أطر السياسات الحكومية والتشريعات الناظمة المعنية.[٤] إذ أن **الإطار القانوني الموثوق** الذي يسهل النشاط الاقتصادي الأخضر، أمر حاسم في اتخاذ القرارات المتعلقة بالاستثمارات وعملياتها المرافقة.[٥] كما أن اتباع أنظمة سياسات عشوائية لا يمكن التنبؤ بها، تؤدي الى إبعاد المستثمرين، كونها تخلق بيئة تتسم بعدم الاستقرار.[٦] ولتوفير مثل هذا الإطار للسياسات التنظيمية وتنفيذه، لا بد من وجود هيئة تنظيمية مستقلة

[٣] http://blogs.worldbank.org/arabvoices/boost-microfinance-arab-world، استرجعت بتاريخ ١٧,٥,٢٠١٧

[٤] Ernst and Young (2015)، التقرير المسحي للتكنولوجيا النظيفة للشرق الأوسط وشمال افريقيا، الطبعة الرابعة، http://www.ey.com/Publication/vwLUAssets/EY-middle-east-and-north-africa-cleantech-survey/$FILE/EY-middle-east-and-north-africa-cleantech-survey.pdf، استرجعت بتاريخ ١٩,٤,٢٠١٧

[٥] Bushehri, F. (2012)، الاقتصاد الأخضر في المنطقة العربية، عرضت خلال ورشة عمل بناء القدرات (TEEB) لمنطقة الشرق الأوسط وشمال افريقيا. https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf

[٦] OECD، التكنولوجيا الخضراء والابتكار. https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/newchallenges/greentechnologyandinnovation.htm- استرجعت بتاريخ ٢٦,١٠,٢٠١٦

ذات مسؤوليات واضحة؛ تضطلع بتحديد الأسعار، ومساءلة جهات محددة مسؤولة عن تقديم خدمات تتسم بالكفاءة وبأسعار معقولة.

ويعد وضع **المواثيق والمواصفات المعيارية** خطوة أساسية نحو وضع مبادئ توجيهية واضحة وشفافة للشركات والمستثمرين، بما في ذلك الحد الأدنى لمعايير كفاءة البناء والمعدات. وعلى الصعيد الإقليمي، تبذل الجهود من خلال لجنة المعايير التابعة لجامعة الدول العربية للتنمية الصناعية والتعدين (AIDMO)، التي تسعى إلى صياغة ومواءمة المعايير المقبولة إقليميا في الدول العربية لتسهيل التجارة البينية والخارجية.

وتحتاج **عملية بناء القدرات** الى إعادة النظر في البرامج التعليمية لضمان تلبيتها لحاجات السوق، وتوسيع البرامج التدريبية أثناء العمل، وتكييف برامج التدريب العالي والمهني.[٧] وستؤدي **التوعية** بحالة البيئة، وأثرها على صحة الإنسان، والفرص والفوائد التي تتيحها التكنولوجيا الخضراء، إلى زيادة الابتكار والطلب على المنتجات الخضراء.[٨] **ويعد التعاون والمشاركة** عبر القطاعات وبين الدول أمرا حاسما ومهما بالنسبة للسياسات الناجحة، فضلا عن جمع وتنفيذ التغذية الراجعة لتوطينها وتبنيها من الجميع.

الخلاصة

ويعتبر تمهيد الطريق نحو اقتصاد أخضر عملية معقدة تتداخل فيها القطاعات، ومن الأفضل أن تعالج على مراحل. وبالنظر إلى التوجه القوي نحو التكنولوجيا الخضراء ضمن آليات تنفيذ الأجندة العالمية للتنمية المستدامة ٢٠٣٠، فلا مناص للحكومات من الشروع بالسير على طريق تعزيز استخدام التكنولوجيا الخضراء في دولها.

وعلى الرغم من محدودية الموارد، فإن حكومات المنطقة العربية تستطيع أن تبدأ عملية الإصلاح بتنفيذ التغييرات عن طريق تطوير المشتريات العامة الخضراء، ووضع المواثيق والمواصفات المعيارية، وتنظيم الأداء البيئي المستدام، حيث تعتبر هذه الاجراءات خطوات سهلة التطبيق. كما أن وضع مواثيق ومواصفات معيارية للبناء يوفر حلولا لمجالات متعددة، ويفضي الى تأثير كبير، نظرا لحجم صناعة البناء الكبيرة.

وبالتوازي مع ما سبق، ينبغي للحكومات أن تزيد التعاون مع البنوك ومؤسسات التمويل لضمان مشاركة القطاع المالي في دعم رواد الأعمال والمبتكرين في مجال التكنولوجيا الخضراء عن طريق تشجيع؛ شركات رأس المال الاستثمارية، والحاضنات والمسرعات، وقروض البنوك المركزية، والقروض المضمونة بالأسهم، وغيرها.

وينبغي أن تهدف استراتيجيات الإصلاح أولا، إلى إلغاء برامج دعم السلع الضارة بيئيا والمطبقة على الموارد بحيث تعكس التكلفة الحقيقية، بما في ذلك التكلفة البيئية، وتضمن في نفس الوقت عدم التأثير السلبي على الأسر

[٧] OECD، التكنولوجيا الخضراء والابتكار، استرجعت بتاريخ ٢٦,١٠,٢٠١٦. https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/newchallenges/greentechnologyandinnovation.htm

[٨] الاسكوا (٢٠١٤)، التكنولوجيا الخضراء في قطاع الطاقة للتخفيف من التغير المناخي في دول منطقة الاسكوا، بيان حقائق. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_sdpd_13_tp-9_e.pdf

الفقيرة والمحرومة. وبذلك يمكن استخدام هذه الوفورات المتأتية في تمويل البحث والتطوير؛ ليس فقط من أجل دعم تكييف التكنولوجيا، بل ولدعم الابتكار الأخضر في ومن المنطقة العربية.

وبالنسبة لجميع الاستراتيجيات الموصى بها؛ فإنه يتعين التخطيط لها وتطويرها عن طريق عملية تشاركية تشمل مختلف ذوي المصالح.

وفي الختام، فإن توفر البيانات، وعمليات الرصد والتقييم، والشفافية، ستفضي الى ضمان تقييم كاف يؤدي الى زيادة تطوير البرامج الناجحة وتوسيع نطاقها، وتحقيق أهداف وغايات التنمية المستدامة.

1. INTRODUCTION

Countries in the Arab region are strongly affected by severe water scarcity, increasing land degradation, rising pollution and unsustainable energy and waste management systems. These phenomena are further accentuated by climate change, population growth and changing consumption patterns. The environmental impact of production and consumption in the region is unsustainable and has serious consequences on current and future economic prosperity and people's well-being.[9]

Green technologies that aim at increasing resource efficiency, harnessing renewable resources or re-using non-renewable ones, can play an important, supportive role in spurring economic growth, reducing production costs and increasing the competitiveness and resilience of businesses and countries, while addressing environmental challenges. Countries leading on green technologies have adopted policies to support the transformation, have created an enabling environment for business owners, and demonstrated the countries' commitment and leadership towards sustainability.

Arab industries are struggling to adopt new technologies and compete with their counterparts from emerging market economies. While technological readiness[10] has slightly improved in the region over the past two decades, it has remained below the worldwide median score in several Arab countries.[11] Moreover, the capacity to innovate remained low and effectively declined in some countries over the past decade. In addition, the region continues to be a user, rather than a generator, of technology. This raises questions regarding the effectiveness of the policies targeted at fostering technological development adopted in the region.

Certainly, the immense difficulties countries in the Arab region face need to be recognized and acknowledged. Many countries in the region face political challenges or suffer from conflict and war. These challenges drive away investment, and lead to economic disruption and infrastructure deficiencies.

In accordance with the 2030 Agenda for Sustainable Development adopted by world leaders in September 2015, the Arab region is committed to achieve inclusive sustainable development by striking a balance between economic, social, and environmental issues while placing the human wellbeing at its center. It is a unique moment for the Arab region to catch on to the global momentum and worldwide support.

[9] Kazzi, H. (2014) *Green Growth and Sustainable Development in the Arab Countries*, European Scientific Journal, Vol 10, No. 14. http://www.greengrowthknowledge.org/sites/default/files/downloads/resource/3429-10054-1-PB.pdf

[10] Technological readiness is defined by the World Economic Forum as the agility with which an economy adopts existing technology to enhance productivity of its industries.

[11] UN ESCWA and UNEP (2015) *Arab Sustainable Development Report*, First Edition, 2015. https://www.unescwa.org/publications/arab-sustainable-development-report-2015

It is widely believed that regional support and investment in green technologies, will assist in addressing many of the challenges that Arab countries face including high youth unemployment, unsustainable resource use and slow economic growth. Many countries in the region have already initiated reforms and a shift towards supporting green technologies, which demonstrate that setting and implementing policies and creating a supportive framework for green technologies creates win-win opportunities.

This report provides an overview of public policies that can be considered by Arab governments to promote green technologies while reducing the risk for businesses and industry and attracting investments at the same time. The recommendations are based on lessons learned from countries within and outside the region. These examples show that businesses are generally motivated to invest in green technologies for reasons related to compliance with new regulations, reaping benefits of favorable policies such as tax breaks and consumer awareness. The main driver for green technology use in a country is thus through strong political will, leadership and commitment. This study demonstrates that the green technology gap can be bridged if decision-makers adopt policies and push-and-pull mechanisms that create an enabling environment and provide adequate capacity building for businesses and industry to invest in green technologies. Economic and regulatory policies need to set a stable framework with long-term environmental management strategies, clear political and legislative mandates, capacity building and knowledge dissemination, economic and fiscal reforms and efficient management of public funds.

The following sections focus on the tools, regulations and policies necessary to create an enabling environment, and present best practices from outside as well as initiatives and trends within the region, providing a pathway for other countries in the Arab region to follow.

2. THE CASE FOR GREEN TECHNOLOGIES

2.1. WHAT IS TECHNOLOGY? WHAT IS GREEN TECHNOLOGY?

Technology is a collection of skills, methods, and processes used in the production of goods and services. It is considered a main driver of economic growth and societal transformation through enhancing efficiency, connectivity and access to resources and services. Simultaneously, technological processes associated with the production of goods and services create unwanted by-products such as pollution, material waste, and may deplete natural resources. However, technologies can be designed to enhance economic and social capitals while reducing the use of natural resources and the impact on the environment. These environmentally friendly

technologies are also termed "green technologies"[12] or "clean technologies" and reduce the adverse effects on the environment, improve productivity, efficiency and operational performance of the technology itself and may be adopted at both the company and national levels.

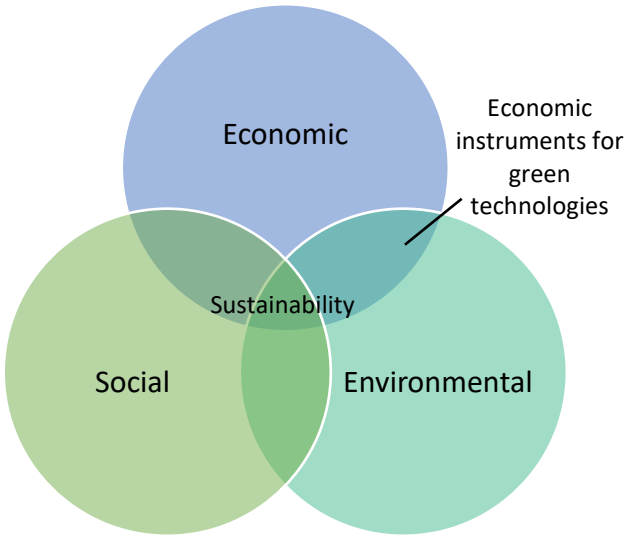
Green technologies are a tool and a pre-requisite to promote a green economy, which is a system of economic activities (production, distribution and consumption, including efficient use and reuse) that results in an improved livelihood over the long term, without exposing future generations to significant environmental risks and ecological scarcities.

Green technologies are crosscutting and indispensable to move towards achieving sustainable development in accordance with the 2030 development framework. Their applications include, for instance, renewable energy (RE) applications, water and energy saving devices, air pollution control, waste management technologies, and sustainable agricultural practices.[13] Information and communication technologies aimed at improving the efficiency of resource use, also contribute to reducing greenhouse gas emissions.[14]

2.2. ECONOMIC, SOCIAL AND ENVIRONMENTAL PERSPECTIVES

Sustainability is based on three main dimensions, namely social, economic and environmental. The focus in this paper is the intersection between the economic and environmental dimension, noting that all dimensions are linked and thus green technology development also affects the social dimension, through for instance job creation, and potentially improved working conditions (for instance in waste management).

Figure 1. Dimensions of Sustainability



From a **social** point of view, green technologies create benefits by improving access to energy services in rural areas, increasing food and water security using more

[12] Green technologies are considered systems that include know-how, procedures, goods and services, equipment, as well as organizational and managerial procedures for promoting environmental sustainability.
[13] Willard, B. (2012) *The new sustainability advantage*, seven business case benefits
[14] Green ICT, http://www.greenict.org.uk/what-is-green-ict, retrieved on 17.5.2017

sustainable agricultural methods[15], improving access to water and sanitation, and reducing health costs associated with pollution and environmental degradation.[16] As such, green technologies could contribute to more socially inclusive development that leaves no one behind. For green technology policies to be effective, they must not only be environmentally sound and economically feasible, but they also need to consider the local and regional specificities and ensure social equity and acceptability.

From an **economic** perspective, green technology advancements can contribute to improved efficiency in production, leading to reduced waste and cost. According to the World Business Council (WBC), industries and companies reap financial benefits from adopting and implementing green technologies, including significant return on investment, cost cuts, enhanced employee productivity, enhanced competitiveness, and process optimization. Technological advancements in renewable energy and energy efficiency will reduce the energy bill while water efficient applications and management will reduce the pressure on this scarce resource. In the Arab region, marked by high unemployment amongst a skilled labor force, investing in green technologies has large potential to create employment opportunities.[17] Emerging economies in Asia for example, are investing heavily in green technologies to remain competitive in the market. It is important that the Arab region seizes the opportunity by investing in green technologies as well, to get access to new and growing markets for green goods and services.[18]

The negative impact of economic growth on the **environment** can be reduced through resource efficiency, which represents the low-hanging fruit to achieve cost reductions and environmental protection. Green technologies for efficiency encompass enhancing machines as well as developing accounting systems, monitoring tools and production processes to render production and operations more efficient. Efficiency refers to changes in equipment and behavior, that results in increased services per unit of the resource (energy, water, soil etc.) consumed, whereas conservation refers to behavioral changes that reduce the consumption of the resource. According to UNEP, resource efficiency alone is set to yield 2 trillion USD globally[19]. Given the low levels of water and energy efficiency in the Arab region, the resources and costs saved by implementing efficiency measures and technologies are likely to have a large impact. While resource efficiency makes economic sense on the balance sheet and benefits businesses and

[15] Bushehri, F. (2012) *Green Economy in the Arab Region*, presentation during TEEB Capacity-building Workshop for MENA Region, https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf
[16] Ibid.
[17] A paper by UNEP on green jobs estimates that as much as 1.4 million green jobs could be created by 2020. This is a "net" number that takes into consideration the job losses in the "brown" economy. UNEP and ILO/IOE/ITUC (2008) *Green Jobs: Towards Decent Work in a Sustainable*, *Low-Carbon World*. http://www.unep.org/civil-society/Portals/24105/documents/publications/UNEPGreenJobs_report_part%201.pdf
[18] Bushehri, F. (2012) *Green Economy in the Arab Region*, presentation during TEEB Capacity-building Workshop for MENA Region. https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf
[19] UNEP, web.unep.org, *Resource Efficiency: Potential and Economic Implications*, retrieved on 20.4.2017.

industries directly, governments should play an important role in capacity building, awareness raising and create incentive schemes.

2.3. APPROPRIATE GREEN TECHNOLOGIES

The green and appropriate technologies' sector is advancing globally, and is gradually spreading in the Arab region. Adopting green technologies is generally case specific, and trade-offs as well as synergies need to be considered beforehand. For example, there are different wastewater treatment technologies with varying energy consumption rates and technical requirements. Similarly, different renewable energy options will have diverse water and land footprints. A nexus approach to green technology selection can thus be helpful in identifying the most "appropriate" green technology options according to local conditions and circumstances. It should be noted that since technology evolves rapidly, what constitutes a green technology today might no longer be considered green in the future. Moreover, the net benefit from any technology will depend on local circumstances.

Although appropriate technology adoption in the Arab region is advancing and showing a modest track record of successful projects, in most countries, enhanced efforts, and additional tools, and policies are needed to evoke the desired transformation of industrial and technological practice in accordance with the principles of appropriate green technology.

The policies adopted to promote green technologies can come at an economic and social cost. For example, import tax reductions on green goods will reduce government revenues. If this reduction is not recouped in a short term, it could have negative impacts on the government's social spending programs. Tools are available to help decision-makers make informed green technology choices. Simple tools include "technology scorecards" that account for resource requirements and environmental impact while combining this information with economic and social-cultural aspects, human capacity and technical requirements.[20]

2.4. THE GLOBAL SHIFT TO GREEN TECHNOLOGIES

The Agenda 2030 for Sustainable Development recognized the interaction and importance of people, planet, peace, prosperity, and partnership (the five P's) in its preamble. The Agenda 2030 specifically refers to Science, Technology, and Innovation directly in eleven out of 17 SDGs and indirectly affects all SDGs (for a detailed list of relevant SDG targets, please see Annex 1).

[20] UN ESCWA (2016) De*veloping the Capacity of ESCWA Member Countries to Address the Water and Energy Nexus for Achieving Sustainable Development Goals - Regional Policy Toolkit.*

Figure 2. Sustainable Development Goals

Source: https://sustainabledevelopment.un.org/

The UN highlighted that to reorient current unsustainable development trajectories over the period 2015 to 2030, affordable, sound, and appropriate technological solutions must be developed and disseminated widely in the next fifteen years. The Addis Ababa Action Agenda proposed mechanisms to implement this ambitious goal, including a holistic framework for implementing SDGs through technology and the establishment of a technology facilitation mechanism.[21] A Technology Bank, led by a governing council and supported by a trust fund, will strengthen national capacity and provide expertise to the world's least developed countries.[22]

Several other international agreements bind and encourage countries around the world including the Arab region to pursue green technologies to reduce harm to the environment. The Paris Agreement, which was negotiated at the 21st Conference of the Parties to the UNFCCC, was adopted in December 2015 and has since been signed by 195 Parties and ratified or otherwise joined by 170 Parties. The Paris Agreement entered into force when at least 55 countries whose collective emissions amount or exceed 55% of global emissions ratified it. This threshold was achieved on Oct 5, 2016 and the Agreement entered into force on Nov 4 2016. So far the following Arab countries have joined the agreement: Bahrain, Comoros, Djibouti, Egypt, Jordan, Lebanon, Mauritania, Morocco, Palestine, Qatar, Somalia, Saudi Arabia, Sudan, Syria, Tunisia and UAE, whereas Iraq, Oman and Yemen have signed it, meaning that they need to proceed to ratification in order to be legally bound to the Convention. To support country efforts to

[21] UN DESA, *Technology: Sustainable Knowledge Platform*. https://sustainabledevelopment.un.org/topics/technology, retrieved on 10.12.2017
[22] UN (2016) *Ban appoints governing body of 'technology bank' for least developed nations*, UN News Centre, 26 Mai 2016. http://www.un.org/apps/news/story.asp?NewsID=54063#.WACjyPl96Uk, retrieved on 20.4.2017

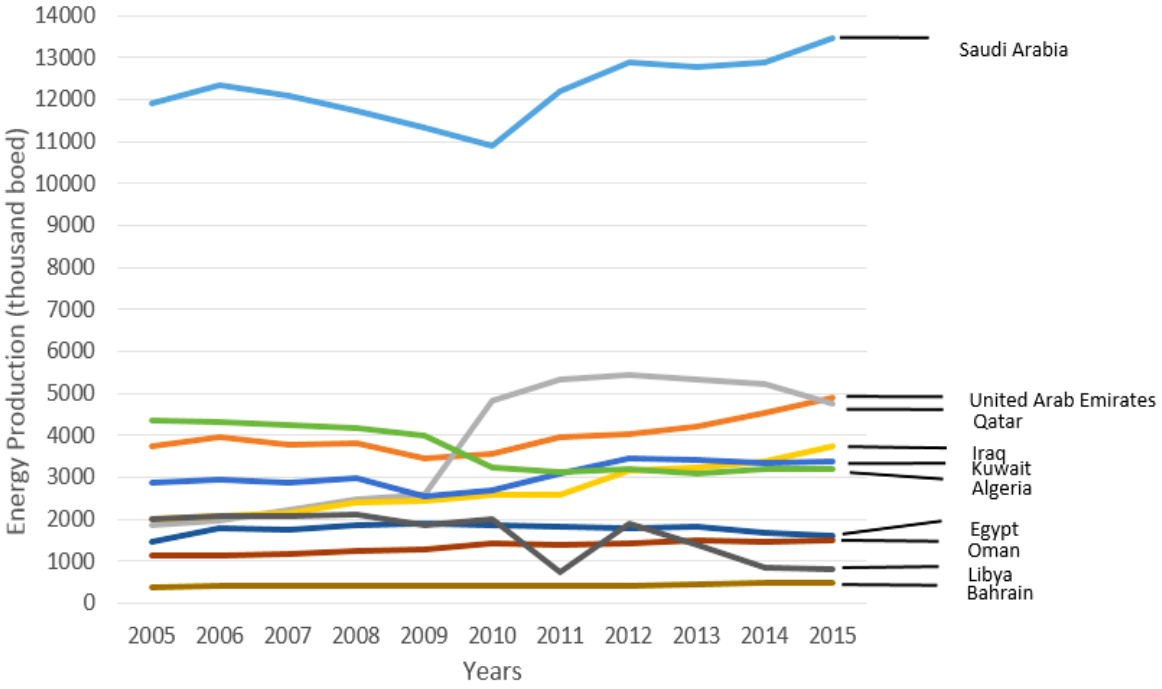
accelerate and enhance action on climate change and transfer climate technologies, a Technology Mechanism, established in the COP 16, is available.

3. OPPORTUNITIES FOR GREEN TECHNOLOGIES IN THE ARAB REGION

3.1. ENERGY

The gas production of the Arab region accounted for 16 per cent of that of the world in 2013 and 30.5 per cent of crude oil production, with the GCC countries being the largest fossil fuel producers in the world. Out of ESCWA member states, Saudi Arabia is by far the largest energy producer in the region, followed by the United Arab Emirates and Qatar.

Figure 3: Total Energy Production, Top 10 ESCWA member countries and Algeria



Source: IEA data adapted by ESCWA

Energy consumption per capita in the Arab region (1,843 kg of oil equivalent) is slightly below the world average (1,897.9 kg), however consumption is increasing strongly, which in some Arab countries is largely attributable to widespread energy subsidies.

Although the Arab Region is not a large emitter overall, several countries in the region have high per capita emissions of greenhouse gases. The Arab region greenhouse gas emissions per capita amount to 5.3 metric tons, which is higher than the world average of 4.9 metric tons. The electricity sector in the Arab region is the main source of CO_2 emissions, accounting for 39 per

cent of the total emissions from all sectors.[23] Economic policies, such as the reform of fossil fuel subsidies and their potential for GHG emission reduction are discussed in the next chapter.

The *Table 1* below paints a picture of the prevailing environmental performance in the Arab region in 2016.

Table 1: Environmental Performance Index in Arab Countries, 2016

Indicator	EPI		Health impacts (environmental risk exposure)		Air quality		Climate change and Energy	
Country	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Tunisia	77.28	53	71.02	90	91.2	34	73.94	66
Morocco	74.18	64	65.55	10	98.57	46	59.61	87
Jordan	72.24	74	64.39	10	75.97	112	85.38	27
Algeria	70.28	83	67.06	10	89.04	48	43.6	103
Bahrain	70.07	86	59.06	119	71.1	131	67.71	78
Qatar	69.94	87	54.02	12	56.54	166	89.35	21
United Arab Emirates	69.35	92	54.5	12	69.47	138	38.49	107
Lebanon	69.14	94	60.34	116	74.44	118	74.74	63
Saudi Arabia	68.63	95	55.46	12	73.64	122	48.3	100
Syria	66.91	101	67.43	99	65.96	149	n.a.	n.a.
Egypt	66.45	104	65.17	10	58.02	164	50.86	99
Kuwait	64.41	113	56.39	125	48.86	172	33.57	111
Iraq	63.97	116	62	112	56.7	165	81.88	39
Libya	63.29	119	66.31	10	84.38	73	54.75	95
Oman	60.13	126	64	10	84.25	75	23.83	113
Yemen	49.79	150	53.53	13	76.65	110	n.a.	n.a.
Comoros	49.2	152	29.6	16	84.95	70	n.a.	n.a.
Mauritania	46.31	160	36.12	15	74.01	119	n.a.	n.a.
Djibouti	45.29	164	56.84	12	85.33	68	n.a.	n.a.
Sudan	42.25	170	39.26	15	77.95	103	n.a.	n.a.
Somalia	27.66	180	26.19	16	68.69	141	n.a.	n.a.
Palestine	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: NA, Not Available

Source: http://archive.epi.yale.edu

The share of renewable energy resources in the Arab region is low at 0.2 per cent and remains far below the world average (4.7 per cent).[24] Renewable energy, other than hydroelectric power,

[23] UN ESCWA (2014) *Green Technologies in the Energy Sector for Climate Change Mitigation in the ESCWA Region*, Fact Sheet. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_sdpd_13_tp-9_e.pdf, last accessed on 19.4.2017

[24] UN ESCWA and UNEP (2015) *Arab Sustainable Development Report*, First Edition, 2015. https://www.unescwa.org/publications/arab-sustainable-development-report-2015

contributes less than 1 per cent of electricity generation in the region.[25] The losses in the distribution grids in the Arab Region are far from reaching the international standards of less than 5 per cent.

There is great potential as well as benefits from investing into renewable energy and energy efficiency in the Arab region. The energy saving potential in intensive energy consuming industries in the Arab countries (IECI) ranges between 15-27 per cent.[26] Investing into energy efficiency and renewable energy would also allow to reduce the dependence on oil and vulnerability to oil price fluctuations.

Globally as well as in the Arab region, the bulk of energy is used in the sectors of electricity generation and industry, which also emit the largest share of GHG emissions, followed by buildings and transport. Renewable energies can contribute to lowering the electricity generations share, whereas buildings offer large potential for energy efficiency gains, which will also lead to demand side reduction of electricity use. Energy efficiency is the most economically viable, since they require fewer investments than renewable energy and end-use sector electrification technologies, such as electric vehicles and heating or cooling systems of buildings.[27] including advanced metering infrastructure, efficient lighting, insulation to reduce heating and cooling, and energy labeling for appliances28. New technologies for buildings include electrochromic windows, which can be darkened or lightened electronically to optimize heat gain while being increasingly affordable and durable. In remote and off-grid areas, appropriate green technologies such as solar cookers and driers can provide opportunities for job creation contributing simultaneously to the achievement of several SDGs.29 Increasing the efficiency of desalination is particularly relevant for the Arab region due to its dwindling water resources. Measures applicable to current reverse osmosis techniques, include using highly efficient pumps and energy recovery devices, whereas innovative technologies such as carbon membranes promise higher efficiency and easier maintenance.[30]

Initial installation costs for deployment of renewable energy remain a disincentive feature in the region. Even though some reports show that RE is already competitive in certain areas, in general, the adoption of projects currently remain at a relatively small scale.

[25] World Bank, *World Development Indicators*; and IEA data. retrieved on 24.11.2017
[26] Sedaoui, R. (2016) *Energy Efficiency in the industrial sector*, International Beirut Energy Forum 2016. http://www.beirutenergyforum.com/p16/Day%201/Session%202/Moving%20Lebanon%20Towards%20Resource%20-%20ESCWA%20prsentation.21.09.pdf, retrieved on 15.4.2017
[27] IRENA (2017) Accelerating the Energy Transitions through Innovation, Working Paper based on global REmap analysis, IRENA, AbuDhabi, www.irena.org/remap
[28] UN ESCWA (2014) *Green Technologies in the Energy Sector for Climate Change Mitigation in the ESCWA Region*, Fact Sheet. https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_sdpd_13_tp-9_e.pdf, retrieved on 15.4.2017
[29] UN ESCWA (2015) *Training Guide: Mainstreaming Appropriate Green Technology Initiatives*, https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/training_guide-_english.pdf, retrieved on 16.4.2017
[30] Rasel Das, Md. Eaqub Ali, Sharifah Bee Abd Hamid, Seeram Ramakrishna, Zaira Zaman Chowdhury (2014) *Carbon nanotube membranes for water purification: A bright future in water desalination,* Desalination, Volume 336, 3 March 2014, Pages 97-109

Governments in the Arab region need to provide favorable policy and investment frameworks for renewable energy resources as a solution to reduce fossil fuel dependence and greenhouse gas emissions, as well as enhance resilience and access through distributed systems in remote areas. In addition, investments should target not only adoption and implementation of foreign technologies, but also the development of the technologies within the region itself to respond to regional demand.

3.2. WATER

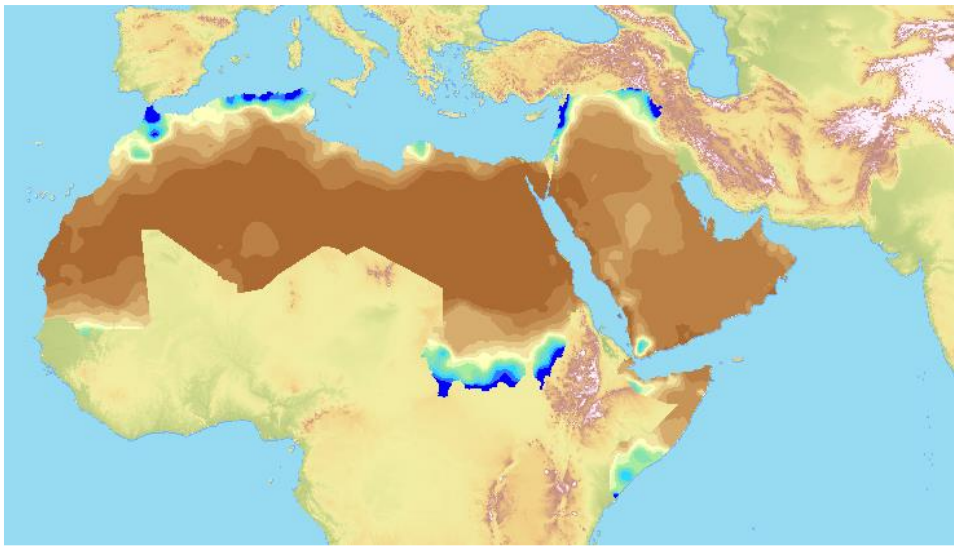
The Arab region met the MDG target of halving the population without access to an improved water source in urban and rural areas. However, aspects of quality, quantity, and consistency of supply were not considered in this measure.

The Arab region is one of the most water scarce regions in the world, accounting for more than 5 per cent of the world population and less than 1 per cent of global renewable water resources.[31] The per capita water resources available in the Arab region are a tenth of the global average. In 2014, 18 of the 22 Arab countries fell below the water scarcity line of 1,000 cubic meters per person per year,[32] while around 40 per cent of the Arab population live in conditions of absolute water scarcity, which threatens livelihoods, particularly of rural and poor communities. Climate change and pollution from agricultural, industrial, and domestic activities represent an additional threat to water resources.

[31] International Fund for Agricultural Development (IFAD) (2009) *Fighting water scarcity in the Arab countries*, http://www.ifad.org/operations/projects/regions/pn/factsheets/WWF_factsheet.pdf, retrieved on 24.4.2017

[32] UN ESCWA and UNEP (2015) *Arab Sustainable Development Report*, First Edition, 2015 (Author's calculations based on FAO, AQUASTAT and DESA, World Population Prospects

Figure 4. Mean annual precipitation distribution across the Arab region (1986-2005)



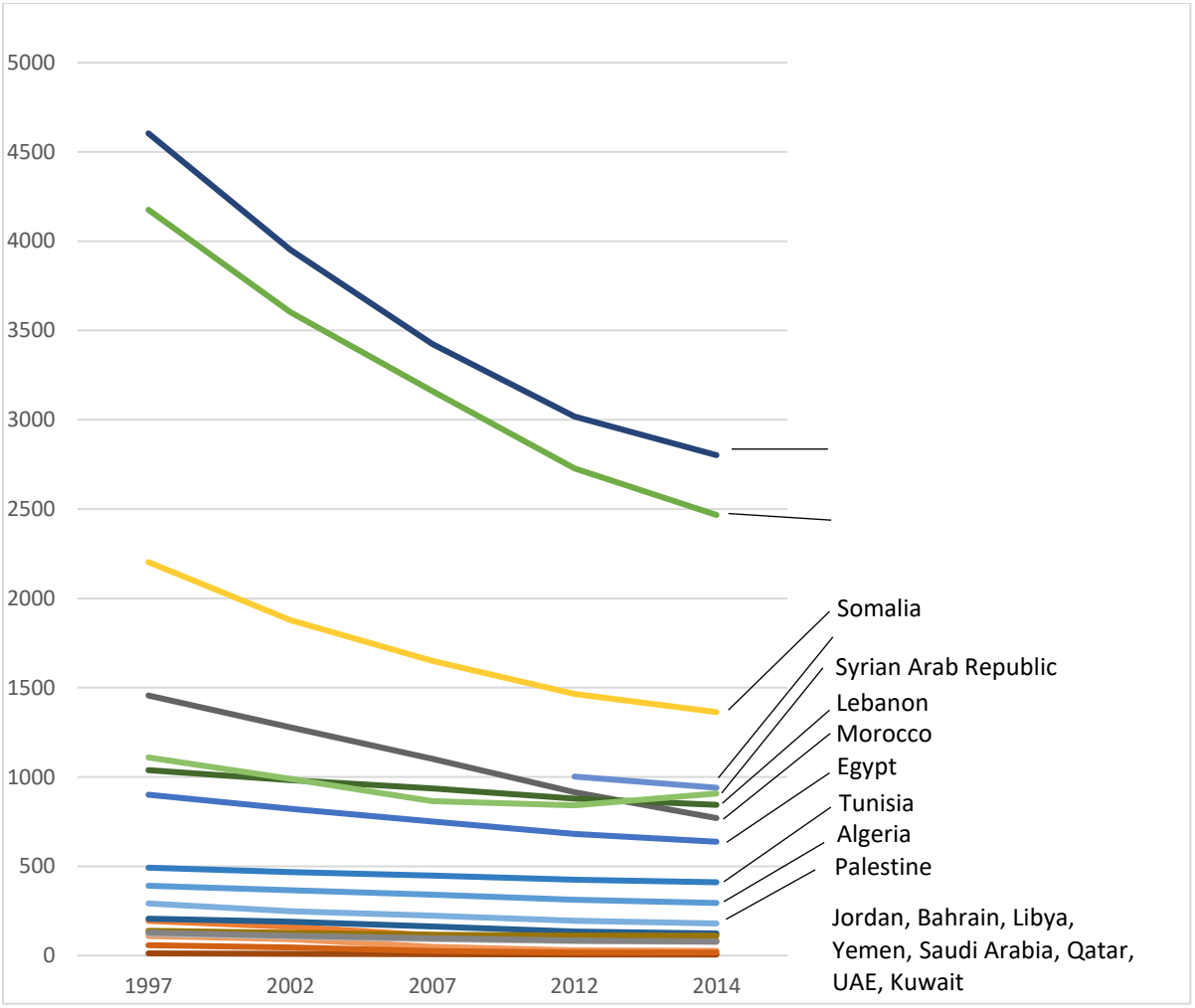
Source: UN ESCWA, RICCAR

Most countries of the region subsidize water, discouraging efficient usage and leading to uncontrolled over-abstraction of water resources. Consequently, annual withdrawals of renewable (ground and surface) water for the Arab region exceed available water and continuously grow, causing aquifer depletion, salinization and seawater intrusion.[33] Annual water withdrawals for the Arab region have been high since the 1990s and have reached alarming levels at over 1,200 per cent of available water in the current decade.[34] Lack of metering of water consumption, insufficient oversight to prevent drilling of illegal wells, and poor maintenance of distribution networks with a high prevalence of leakage all contribute to non-revenue water.

[33] Ibid.

[34] FAO, Aquastat, retrieved on 10.11.2017

Figure 5. Total renewable water resources per capita (m3/inhab/year)



Source: FAO, Aquastat

To meet future domestic water needs, Arab Governments will need to either reduce demand, divert water from the agricultural sector, or resort to non-conventional water sources.[35] The GCC countries host nearly half of the global desalination production capacity. The cost of desalination is falling but can still be as much as $1.50 per delivered cubic meter, in contrast to the subsidized price of 4 cents per cubic meter at which some Arab countries sell water. Nevertheless, while desalination alleviates the burden on conventional water sources, it creates environmental and energy costs.

In terms of wastewater reuse, Arab countries produce 10.8 billion cubic meters per year of wastewater out of which around 60 per cent is collected and treated and only 20 per cent is reused in irrigation and industrial applications. Desalination, water harvesting, and wastewater

[35] IFAD (2009) Fighting water scarcity in the Arab countries, https://www.ifad.org/documents/10180/7f193193-023f-4ede-8e33-038aa1b53aa3. Last accessed, 17.10.2017

recycling have limits in terms of quantities of scale since together they could amount to 20–25 per cent of abstracted water.[36]

The use of economic policy instruments combined with better monitoring and enforcement would incentivize using water more efficiently at all levels and subsequently the need for green technologies. These could include more efficient irrigation practices through sound crop selection, irrigation scheduling, or a tax on pesticide and fertilizer use.

3.3. WATER ENERGY NEXUS

The interlinkages between water and energy in the Arab region are very important and can be put to good use in the form of novel approaches to sustainably manage overconsumption of both resources. The Water Energy Nexus approach recognizes that water is essential in providing energy, just as energy is needed to provide water. Thus, water constraints can become energy constraints, and vice versa. All sources of energy (including electricity) require water in their production processes: the extraction of raw materials, cooling in thermal processes, cleaning processes, cultivation of crops for biofuels, and powering turbines. Energy is itself required to make water resources available for human use and consumption (including irrigation) through pumping, transportation, treatment, and desalination.

In the Arab region, this link between water and energy and their complementarity is further tightened due to extreme water scarcity. It is also important to note that while investment in green technologies is essential, policy-makers should also be careful about potential negative side-effects. Wind and solar energy have great potential for improving water supply in rural areas through pumping water. In areas where the cost of water is low or not priced, the price of pumps running on fossil fuels is one of the few factors limiting over-abstraction; therefore, implementation of renewable energy for water pumping should be accompanied by an adequate policy on water management, for instance effective metering.

Jordan's water pumping consumes over 15% of total power production.[37] The country increasingly uses solar energy for pumping water, particularly for users that are located far away from the source.[38] A European Union grant worth 30 million euros enabled a project that installed solar power to operate five of the Kingdom's main water pumping stations by 2018. At the same time, Jordan's water resources were suffering from over extraction of water. In response, the Ministry of water and irrigation in Jordan is applying effective water management,

[36] World Bank, FAO and IFAD (2009) *Improving Food Security in Arab Countries*
[37] Jordan Times, (2017): http://jordantimes.com/news/local/five-water-pumping-stations-operate-solar-power-water-ministry, retrieved on 24.04.2017
[38] Majd Al Naber (2017) *Groundwater governance in Azraq Jordan*, Retrieved on 15.06.2017 http://gw-mena.iwmi.org/wp-content/uploads/sites/3/2017/04/Rep.12-Groundwater-governance-in-Azraq-Jordan-report_final_cover.pdf

adequate metering and cost recovery, with initial positive results. Continuing efforts will help reduce over extraction of water while also reducing the energy consumption for water pumping.

3.4. WASTE

Municipal waste generation in the Arab Region is 93.2 million tons per year with an average per capita generation of 0.89kg/p/day and the volume of municipal solid waste produced grows by up to 3% per year. Large discrepancies exist between least developed countries and rural areas, which produce less waste, and countries with higher living standards and in cities, which have higher waste generation rates. Municipal solid waste in the Arab region faces many challenges including; inadequate planning and improper disposal, high population growth, limited collection services, inappropriate use of technology, and limited financing.[39] In many Arab countries, up to 50 per cent of the waste generated goes uncollected, and collected household waste is mixed with industrial and medical waste during handling and disposal.[40] Most of waste reuse and recycling activities are run by the informal sector and NGOs.[41] On average, in most of the Arab region, the major part of collected municipal waste is either openly dumped or landfilled, and only a small percentage amounting to 1-3 per cent is recovered as recyclable material[42]. The reasons for inefficient waste management include the fact that the sector has received limited attention so far, the absence of political will, insufficient institutional and legal frameworks providing incentives, as well as the lack of reliable data, technical expertise and public awareness.

Waste management policy in the Arab region needs to focus on reducing waste generation and resource efficiency to reduce the financial and environmental cost of waste. The reuse and recycling components provide potential for job creation as well as improvement for public and environmental health. Appropriate technologies range from recycling and sorting lines, to composting methods adapted to the regional characteristics, and finally technologies such as mechanical-biological-treatment, refuse-derived-fuel, as well as biogas. Cost-recovery instruments such as waste generation charges, tipping fees, and pollution taxes are amongst the more commonly used economic instruments to ensure return on investments for technology and to cover operational cost. It also provides opportunities to invest in environmental conservation to offset the deterioration caused by landfills.

[39] Elnass, A. A. (2015). *Actual situation and approaches for MSW treatment in the Arab Region.*
[40] Ezzine, M. (2015) *Review of Innovative and Appropriate Technologies for Waste Management in Morocco and the Arab Region*, Casablanca, 29th-30th September 2015
[41] Rami El- Sherbiny et al., (2011), *Waste Management, Arab Forum for Environment and Development.*
[42] Elnass, A. A. (2015). *Actual situation and approaches for MSW treatment in the Arab Region*

3.5. TRANSPORT

The number of passenger cars in the Arab region in 2014 was estimated at 94 per 1,000 people and several Arab countries face an increase in vehicles per km of road. The transportation sector consumes about 64 per cent of petroleum consumption globally, equaling 27 per cent of all energy uses, compared to 32 per cent of total energy uses in the Arab region. The transport sector globally releases about 25 per cent of CO_2 emissions, similarly to the Arab region where the transport sector accounts for 23 per cent of the total greenhouse gas emissions, of which 85 per cent is attributed to in-land transportation.

In the Arab region, the sector is mainly characterized by an aging, poorly maintained vehicle fleet, and inefficient use of fossil fuel, which results in increasing fuel consumption, growing greenhouse gas emission and an increased traffic congestion representing one of the most polluting sectors in the Arab region. [43] Public transport is inadequate and transitioning towards a more sustainable transportation sector would require Arab countries to adopt alternative green transport technologies and solutions. Measures can range from the improvement of public transport networks and routes to providing the possibility and incentives for walking or cycling. An example for innovative technology comes from China, which operates the Transit Elevated Bus[44] running on electricity generated by solar panels.

Green transport is predicted to create less demand for private car ownership and reduce the number of passenger cars and fatal accidents, generate fuel cost savings, and provide enhanced mobility to places of work and minimizing time losses in congested roads.[45]

4. ECONOMIC POLICIES TO PROMOTE ADOPTING GREEN TECHNOLOGIES IN THE ARAB REGION

A combination of tools is needed to prepare the ground for a conducive environment necessary to improve resource management, including market-based interventions such as taxes, fees, and subsidies as well as a comprehensive legal framework, political will, and standards specifically adapted to the circumstances of countries of the region. This section outlines direct governmental drivers as well as non-governmental actions using economic policies to promote the dissemination of green technologies in the Arab Region.

[43] UN ESCWA and UNEP (2015) *Arab Sustainable Development Report*, First Edition, 2015. https://www.unescwa.org/publications/arab-sustainable-development-report-2015

[44] RT News. (August 3, 2016). *Futuristic bus that drives above car traffic goes on test run in China*. Retrieved September 25, 2016, http://on.rt.com/7lhb

[45] Kaysi Chaaban, (2015), Sustainable Transport in the Arab Region.

4.1. SUBSIDIES

A subsidy is money granted by a public body to help an economic sector (industry or business) to keep the price of a commodity or service low or affordable (for an economic or social objective). Subsidies can materialize as tax breaks, exemptions from government regulations, financing from state-owned financial institutions, purchase requirements or other options.[46] Well-designed subsidies can be used to mitigate an environmental problem, with the clear example of supporting to renewable energy technologies to attract investors in that field.

The Jordanian Renewable Energy and Energy Efficiency Fund (JREEEF) is currently implementing a strategic plan to provide renewable energy subsidies targeting vulnerable segments of society including schools, mosques and churches, and eligible households. JREEEF is allocating 50 million Jordanian dinars from government and donor sources (more than 71 million dollars) to subsidize up to 50% of the incurred cost. The fund has implemented projects in 60 schools, 2500 mosques installing one million energy efficient electric bulbs, 100,000 household solar panel and 200,000 solar water heaters.[47]

Another example of effective subsidies is the Tunisia Solar Programme (PROSOL), a joint initiative of UN Environment, The Tunisian National Agency for Energy Conservation and the Societe Tunisienne de l'Electricite et de Gaz (STEG) initiated in 2005. PROSOL provides subsidies for the capital cost of solar water heaters for the residential sector. The program combined several economic instruments, providing loans through commercial banks at a reduced interest rate in addition to a capital cost subsidy of 20% of system costs. The project's achievements are far-reaching: over 50,000 Tunisian families use solar water heaters, over 1000 companies were involved in installing systems and 42 suppliers were registered, thus creating green jobs. The project contributed to the prevention of 240,000 tons of cumulative CO2 emissions and reduced the reliance on imported fuel. The project under the Nationally Adapted Mitigation Actions (NAMA) is now being scaled-up through a financial, technical and communication and awareness support program. The project is expected to result in the installation of 134 MW additional PV in the building sector and reduce GHG emissions by 390500 t CO2e in the period 2019-2023.[48]

The use of subsidies is recommended only to a limited extent and should be considered together with other economic policy instruments to achieve positive outcomes by promoting environmentally sound practices and sustainable use of natural resources.

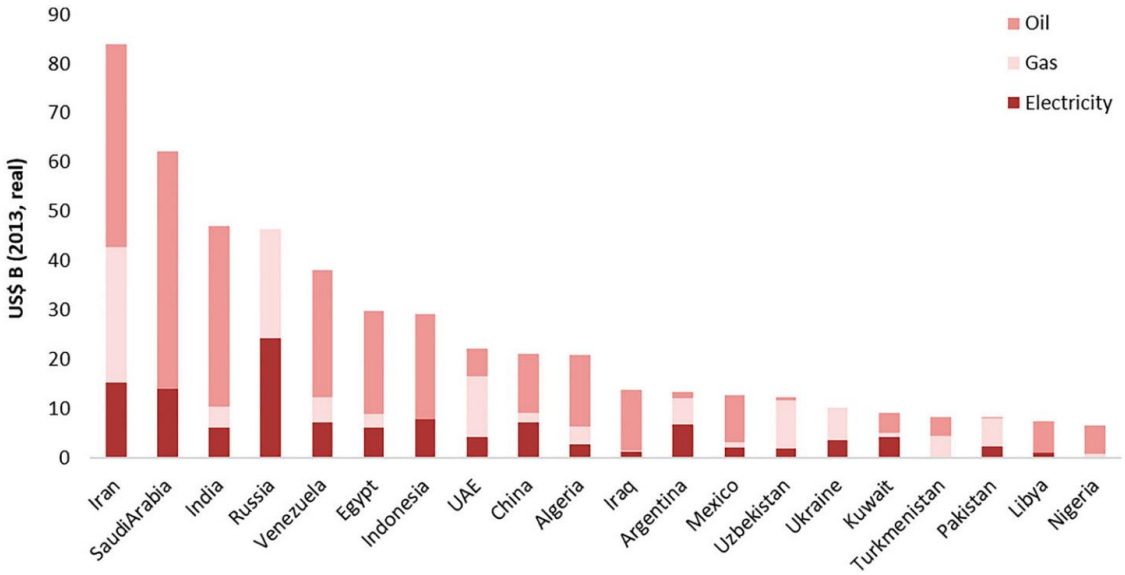
Subsidies may lead to market distortions and unintended negative consequences. The clear example in the Arab region comes through fossil fuel subsidies. They are seen to encourage

[46] Hsu, A. et al. (2016). 2016 Environmental Performance Index. New Haven, CT: Yale University. Available: www.epi.yale.edu.
[47] The report: Jordan 2011, Oxford Business group.
[48] NAMA Facility, http://www.nama-facility.org/projects/scaling-up-renewable-energy-and-energy-efficiency-in-the-building-sector/, retrieved on 10.11.2017

inefficient allocation of scarce resources, increased consumption of energy, and discouraged investments in more efficient and sustainable systems.

Most countries in the Arab region heavily subsidize energy prices. In 2011, for example, the Arab region spent approximately 9 per cent of GDP on energy subsidies in order to keep prices low, which encouraged wasteful use amounting to half of global subsidies.[49]

Figure 6. The 20 largest subsidizers of energy consumption



Source: IEA, 2014a, in Jun Rentschler & Morgan Bazilian (2017) Reforming fossil fuel subsidies: drivers, barriers and the state of progress, Climate Policy, 17:7, 891-914, DOI: 10.1080/14693062.2016.1169393

Subsidies are often argued to benefit the poor; however, studies by the International Monetary Fund have shown that more than 40 per cent of fuel price subsidies in developing countries accrue to the richest 20 per cent of households.[50] Moreover, direct or hidden subsidies have harmful impacts and send the wrong signals by pricing environmental resources inappropriately.

There are numerous examples of phasing out of subsidies, which show that pricing fossil fuels appropriately can provide a powerful incentive for increasing the use of renewable energy.[51],[52] Periods of oil prices drop create windows of opportunity for the reduction of fossil fuel subsidies,

[49] IMF (2014), Subsidy Reform in the Middle East and North Africa: A Summary of Recent Progress and Challenges Ahead, retrieved on 20.5.2017

[50] International Monetary Fund (2013) *Energy Subsidy reform in Sub-Saharan Africa, experiences and lessons*, Washington, D.C.. https://www.imf.org/external/pubs/ft/dp/2013/afr1302.pdf, retrieved on 17.5.2017

[51] https://www.cbd.int/financial/fiscalenviron/g-subsidyreform-oecd1998.pdf

[52] Withana, S. (2014) *Reforming environmentally harmful subsidies in Europe: the way forward*, IEEP. http://www.ieep.eu/assets/1347/Reforming_EHS_-_The_way_forward_-_Sirini_Withana_-_24_February_2014_final.pdf

which allows to enhance the competitiveness, attracts investments and helps to stabilize the macroeconomic environment.[53]

Governments in the Arab region became increasingly aware of the need to reform the subsidy system and there is a growing consensus that energy subsidies should focus on expanding access to technology, developing and disseminating cleaner fuels, and increasing end use efficiency—not promoting consumption. All GCC countries (UAE, Saudi Arabia, Oman and Bahrain) as well as Jordan, Egypt, Algeria and Tunisia started cutting environmentally harmful subsidies and raising oil prices domestically. Although this action was mainly for economic and fiscal reasons, such reform will lead to emission reductions and subsequently environmental and health benefits. Moreover, the Arab region prepared the ground for more conducive shift to renewable energy through the Pan Arab Strategy of Renewable Energy 2030, the Arab Renewable Energy Framework, and renewable energy targets announced by twenty Arab countries.

Any price reform is likely to have an impact on the competitiveness of the industry and the profit margins of companies, subsequently affecting prices for the final consumer and household budgets. Governments must ensure that a program of gradual price rises is linked to stronger institutional and legislative support for energy efficiency, thus creating a conducive environment for green growth and technology locally and globally.[54] While price reforms may be challenging to implement in the short term, in the long term they create benefits for the society, the economy and environmentally, since the environmental cost of consuming the resource is not reflected in current prizes.

[53] Schwab, K. (2017) *The Global Competitiveness Report 2016-2017*, World Economic Forum
[54] Jadwa Investment (2016), *Inflation Report*: January 2016 (in Arabic)

4.2. ENVIRONMENTAL TAXES

Taxes aim at incorporating the social cost into the market price of a good or service. Taxes for energy include carbon taxes levied on fossil fuel (a tax per unit ton of emissions) or taxes on energy inefficient goods such as vehicles with high gasoline consumption, whereas water pollution taxes consist of compulsory payment to the fiscal authority for a behavior that leads to the degradation of the water environment. Taxes encourage the taxed person to adopt alternative behaviors since the user will aim to shift towards cheaper and less polluting techniques and green technologies.[55] A tax is often preferred to other carbon-reducing measures including strict legislation or subsidy and provide an additional revenue for the government.

The tax rate is usually fixed to represent an incentive for pollution reduction and allows the polluter to decide on ways of pollution abatement.[56] However, setting the tax rate correctly requires the availability of reliable data on the marginal social damage of pollution, which often remains uncertain.[57] In addition, ensuring tax collection and compliance requires high administrative costs and efforts. Taxes may have negative impacts on economic development in poor countries. A carbon tax for example would lead to higher energy prices, thus increasing the burden on businesses and the poor.

In British Columbia, Canada, a carbon tax has been in place since 2008, demonstrating economic growth, increase in clean-tech jobs, and reduced pollution. The Canadian government opted for establishing a revenue-neutral carbon tax, meaning that the money collected by the state is returned to people and businesses through tax breaks. While it renders petrol and electricity more expensive, many families can save money through accompanying tax breaks, whereas larger polluters should gradually shift to cleaner energy solutions.[58]

Environmental taxes are not commonly applied in the Arab region. According to the Carbon Tax Center, no Arab country has implemented a carbon tax yet.[59] Some Arab countries use tax income tax exemption schemes for enterprises installing environmentally friendly technologies, pursuing energy efficiency or businesses applying waste treatment techniques.[60]

In the Arab region, economic policy instruments for environmental management are often feared to lead to social injustice, trade protectionism, or conditionality on aid. The social impact of a tax,

[55] Delacamara, G., Dworak, T., Gomez, C.M., Lago, M., Maziotis, A., Rouillard, J., Strosser, P. (2013) *Design and Development of Economic Policy Instruments in European water policy*, FEEM project. http://www.feem-project.net/epiwater/docs/epi-water_guidance_v2.pdf
[56] Hesse, D.M. (2013) *Fostering green technological innovations: The role of environmental policy*, UNECE. https://www.unece.org/fileadmin/DAM/SPECA/documents/kdb/2013/Seminar_Kazakhstan/3_Hesse.pdf
[57] Marrouch, W., *Environmental Taxes Between Theory and Practice*, http://css.escwa.org.lb/sdpd/1610/S410.pdf
[58] Economist (2014) *British Columbia's carbon tax – The evidence mounts*, 31 July 2014, Vancouver. http://www.economist.com/blogs/americasview/2014/07/british-columbias-carbon-tax
[59] Carbontax, *Where Carbon is taxed*, https://www.carbontax.org/where-carbon-is-taxed/, retrieved on 17.10.2017
[60] UN ESCWA (2011) *Green financing for the Arab Region*, Background Paper for the regional Preparatory Meeting Series for Rio+20 on Economic Policies Supporting the Transition to a Green Economy in the Arab Region. http://css.escwa.org.lb/SDPD/1610/sdpd11_en.pdf

however, strongly depends on the nature of the tax and related tax breaks. The use of tax revenues needs to be transparent and linked to the purpose they were collected for, to increase citizen trust. Many consider taxation as an indicator of the legitimacy of the state.[61]

Egypt introduced a set of incentives including offering tax exemptions for companies using natural gas vehicles in the first few years, cutting conversion costs for vehicle owners, and introducing a competitive gas price compared to gasoline.[62] To promote conversion to natural gas in Egypt, the government implemented an initiative to replace a fleet of old polluting taxis with modern CNG-fueled vehicles. The initiative started in Metropolitan Cairo and expanded to other governorates. Barriers to the implementation of the project include high cost of conversion and limited areas in gas stations. The government provided concessional loans, exempted new locally-assembled CNG vehicles from about 55% of customs and consumption taxes, and allowed existing fuel stations to provide the CNG service. The adopted policy to switch to natural gas lead to significant improvement of air quality reduction in emission levels (reduction of 86% for carbon mono-oxide CO, 83% for non-methane hydro carbons, and 25% for nitrogen oxides NOx and carbon dioxide CO2.)[63] Egypt also offered a tax reduction for 10 years for projects focusing on:

- the reclamation and cultivation of barren and desert lands,
- livestock production,
- bee-keeping and
- fish farming.

4.3.TARIFFS AND FEES

Tariffs are a price set by the regulator for a service and reflect the cost of using the resource. Fees are payments for a service directly or indirectly associated with the degradation of the environment. Tariffs and fees create incentives to reduce consumption of resources and encourage adoption of green technologies for more efficient infrastructure and appliances. They also generate revenues for services and infrastructure.[64] Possible negative effects may include excessive financial burden on poorer households, which should be addressed by proper design with income support policies protecting vulnerable social groups. To implement tariffs,

[61] Whitaker, B (2010) *Why taxes are low in the Middle East*. The Guardian. https://www.theguardian.com/commentisfree/2010/aug/23/why-taxes-low-arab-world

[62] UN ESCWA (2009) *Transport for Sustainable Development in the Arab Region*: Measures, progress achieved, Challenges and Policy Framework.

[63] Ibrahim Abdel Gelil (2011), *Improvement of the Air Quality in Egypt: The role of natural gas*

[64] European Commission (2013) *Evaluating Economic Policy Instruments for Sustainable Water Management in Europe*, Synthesis report of the EPI-Water FEEM-project. http://www.feem-project.net/epiwater/docs/epi-water_DL_5-1.pdf

authorities need to be able to regulate the consumption of a good or service such as electricity or water and have monitoring systems in place at individual user levels.[65]

Tariffs on water and sanitation services are applied in numerous countries in the Arab region, often taking the form of fixed charges or water use charges or a combination of both. However, municipal water tariffs in most of the Arab countries are low and do not provide an incentive for consumers to save water. Billing, metering, and revenue collection are major issues in most Arab countries, especially when implemented for water pricing for irrigation.[66] A progressive water tariff ensures that basic human needs for fresh water are met at a subsidized price, while additional consumption is priced at a higher tariff that reflects cost.[67] In Jordan, Tunisia, and Morocco, tariffs on water and sanitation are progressive and users are divided into different categories (blocks) based on the level of consumption. The tariff rises when moving from one block to another based on the assumption that the level of consumption is reflected in the income of the household.

In the province of Ravenna, Italy, irrigation water for farmers was priced according to an area-based water tariff which was considered socially unacceptable because the allocation of costs was not related to actual use. In 2006, it was adapted to a volumetric water pricing system as a means of cost recovery for the delivery of irrigation water. The volumetric pricing consists of 3 parts, a fixed component, which is paid only by non-irrigators and representing payment for operating costs, a volumetric component representing the real water use quantified by water meters and paid only by irrigators, and a third variable component that recovers the costs not covered by the first two components which is paid by irrigators to cover expenses such as unmetered water use. The participation of farmers in the decision-making process was important and led to a more rational use of water by irrigators. [68]

Tariffs commonly used in the energy sector are **Feed-in-tariffs (FiT),** designed to guarantee a higher return to clean energy producers above the existing market price. They have the potential to encourage investments in green energy technologies, since renewable energy producers receive a long-term price guarantee for the electricity produced. However, FiT are criticized for their market distortions and fragmentation in the wholesale market and locking in subsidies that can become politically difficult to remove unless time limits are set.[69] Countries that phased out

[65] Delacamara, G., Dworak, T., Gomez, C.M., Lago, M., Maziotis, A., Rouillard, J., Strosser, P. (2013) *Design and Development of Economic Policy Instruments in European water policy*, FEEM project. http://www.feem-project.net/epiwater/docs/epi-water_guidance_v2.pdf
[66] Arab Development Portal (2015) *Establishing Effective Water Tariff Policies in the Arab World*, 17 February 2015. http://www.arabdevelopmentportal.com/blog/establishing-effective-water-tariff-policies-arab-world
[67] Zubari, W. (2015) *Sustainable Water Consumption in Arab Countries*, in Arab Environment: Sustainable Consumption, Arab Forum for Environment and Development, http://www.afedonline.org/Report2015/English/p108-133%20water%20english%20today.pdf, retrieved on 21.5.2017
[68] Delacamara, G., Dworak, T., Gomez, C.M., Lago, M., Maziotis, A., Rouillard, J., Strosser, P. (2013) *Design and Development of Economic Policy Instruments in European water policy*, FEEM project. http://www.feem-project.net/epiwater/docs/epi-water_guidance_v2.pdf
[69] Wess (2011) *National Policies for Green Development*, Chapter 5 in World Economic and Social Survey 2011. http://www.un.org/en/development/desa/policy/wess/wess_current/2011wess_chapter5.pdf

FiTs are faced with reduced solar deployments, leading to business failures, job losses and a drop in renewable energy generation capacity. [70] Several countries in the Arab region have implemented FiTs (Jordan, Egypt, Algeria, and Palestine)[71] and several others are planning to (Morocco, Tunisia).

Algeria introduced FiTs in 2014, to encourage the use of renewable energy technologies. The government required utilities to buy electricity from renewable energy producers above the retail rates through a 20-year power purchase agreement (PPA), guaranteeing long-term security to investors. Base tariffs will range from 12.75 Algerian dinars per kilowatt hour (DZD/kWh) (approximately 11.87 US cents) to 15.94 DZD/kWH (approximately 14.83 US cents) for solar PV projects. Following an initial five-year phase the applicable feed in tariff will be revised based on the plant's effective output. The FiT is expected to enhance adoption of green energy technologies and renewable energy production equivalent to 22 gigawatts capacity which is 27% of the total energy needs by 2030.[72]

Germany introduced FiTs in 2010 to encourage the use of renewable energy technologies. The government required utilities to buy electricity from renewable energy producers above the retail rates through 20-year contracts, to provide investment security. The FiT led to a boom in adoption of green energy technologies and renewable energy production, from 6% in 1990 to 33% in 2015. The tariffs are lowered every year to encourage more efficient production of renewable energy, which led to a peak and subsequent decline of solar growth. The German Government will start a competitive bidding system from 2017 on, where a project will go to the bidder with the lowest revenue per KWh.[73]

As the below tables show, some countries supported the reform by introducing mitigating measures. Price increases were sudden, and few countries explained the need for reform to the public. Moreover, reforms were enacted under fiscal and external pressures and were often not linked to pricing formulae. For a table showing reform measures to reduce electricity consumption in selected Arab countries, please refer to the Annex.[74]

4.4. GREEN PUBLIC PROCUREMENT

[70] Eversheds (2015) *UK solar industry – impact of proposed changes to Feed-in Tariff regime,* http://www.eversheds.com/global/en/what/articles/index.page?ArticleID=en/Construction_And_Engineering/Impact_of_proposed_changes_to_Feed-in_Tariff_regime

[71] APICORP (2016) *Renewables in the Arab world: a new phase,* in APICORP Energy Research Vol.1, No. 5, http://apicorp-arabia.com/Research/EnergyReseach/2016/APICORP_Energy_Research_V01_N05_February_2016.pdf

[72] www.pv-magazine.com, retrieved on 18.5. 2017

[73] Power Technology (2016) *Germany's Energiewende: a renewable revolution on the ropes,* 5 September 2016. http://www.power-technology.com/features/featuregermanys-energiewende-a-renewable-revolution-on-the-ropes-4989873/

[74] IMF (2014), *Recent Experiences of Subsidy Reform in the Middle East and North Africa, IMF*

Governments can use their purchasing power to choose environmentally friendly goods and services. Green public procurement (GPP) spurs innovation and helps shift consumption to sustainable patterns through creating the demand in the market. Governments should lead by example using sustainable public procurement to stimulate demand for green products and services using resource-efficient technologies such as clean fuel purchasing for the government fleet itself.[75] To be effective, GPP requires the inclusion of clear and verifiable environmental criteria for products and services in the public procurement process.[76]

Several countries in the Arab region incorporate sound environmental principles in their procurement policies, and many are collaborating with international partners to set and comply with standards and guidelines. Successful examples include UNEP's Sustainable public procurement program with many Arab countries participating (Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine, Tunisia and the UAE). Several countries have special provisions to encourage green procurement (Morocco, Tunisia, Yemen, Palestine and UAE) and can provide lessons learnt to other countries in the region.[77] The UNEP Sustainable public procurement program helps the countries develop and implement national strategies.

Dubai has made significant advancements in the last years concerning Green Procurement, requiring government entities to consider the objective of reducing transport fuel, electricity and water consumption in their purchasing choices. Green Procurement in Dubai has already completed first milestones, including the issuance of Green Public Procurement Guidelines in 2015, capacity building of relevant entities, the appointment of Green Procurement Officers, as well as the definition of baselines and targets. A pilot regulation on indoor lighting with specific criteria has been issued, with regulations on electric motors and vehicles, IT, AC and Irrigation equipment, indoor water fixture and solar panels in progress. The purchasing criteria include for instance the use of LED technology when technically possible, whereas mercury vapour and incandescent lights including halogen lamps are prohibited.[78]

4.5. PUBLIC INVESTMENT

Governments generally invest heavily in public infrastructure projects. Choosing green technologies for such investments can help drive businesses and production as well as innovation. Governments should use such opportunities to lead the way towards sustainable

[75] Bushehri, F. (2012) *Green Economy in the Arab Region*, presentation during TEEB Capacity-building Workshop for MENA Region https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf
[76] European Commission (2016) *Buying green – a handbook on green public procurement*, 3rd Edition. http://ec.europa.eu/environment/gpp/pdf/Buying-Green-Handbook-3rd-Edition.pdf
[77] OECD (2016) *Stocktaking Report on MENA Public Procurement Systems*, MENA OECD Network on Public Procurement, https://www.oecd.org/governance/ethics/Stocktaking_MENA_Public_Procurement_Systems.pdf, last accessed 17.10.2017
[78] Dubai Supreme Council of Energy (2017) *Green Public Procurement for Energy and Water Efficiency*, Roll-out workshops, http://taqati.ae/wp-content/uploads/2017/01/20170111_GPPEWE-Criteria_Roll-out-workshop_vff.pdf, last accessed 17.10.2017

consumption and production through creating demand for environmentally friendly products and services.

The train of the holy ritual sites in Saudi Arabia is a metro line in the city of Mecca designed to have the highest capacity of any metro in the world. It operates during Hajj peak times as a shuttle train between holy sites in Mecca, Mount Arafat, Muzdalifah, and Mina to reduce congestion caused by vehicles of visiting pilgrims. The line was inaugurated on November 13, 2010 and provides transport for about 3.5 million people who arrive to Mecca annually to perform Hajj. The number is expected to increase to five million in future. The main benefits of the train include alleviating crowding and accidents related to congestion and reducing emissions for a huge fleet of about 4000 shuttle busses. The Mecca monorail project has been one of many undertaken by Saudi Arabia to expand its railway network to meet the transportation needs of its growing population of 25 million and improve an antiquated logistics infrastructure. The line can transport about 500,000 pilgrims in six to eight hours. Moreover, it has also allowed authorities to reduce the number of buses needed to transport pilgrims from 70,000 to 25,000.

Other efforts related to green transport in Arab countries include fuel conversion of public transportation fleet from fossil to gas in Egypt, promotion of hybrid or fully electric passenger cars, and the construction of the infrastructure for the rapid express bus in Jordan.

4.6. TRADABLE PERMIT SYSTEMS

A cap and trade system is a market-based approach to controlling pollution that allows governments to trade emissions' allowances under an overall cap, or quota, on those emissions. To set up a tradable permit system, the amount of the available traded good (resource or pollution) is measured and a maximum limit is set. Carbon trading puts a cap on the total amount of greenhouse gas emissions and allocates emission allowances, which users can trade. Participating actors monitor and report their emissions; they can purchase allowances if their emissions exceed the permitted allocation, or sell if they performed well. Trading of permits or allowances requires the establishment of a market. Trading schemes encourage the adoption of efficient and less polluting technologies and may improve the allocation of the resource amongst users as well as reducing the abatement costs.[79]

Trading schemes have been effective in certain contexts but have also been criticized for over-allocating allowances and uncertainty, which gives little incentive to comply with the scheme or to innovate. They also raise questions about equity since treating a resource as an economic

[79] Delacamara, G., Dworak, T., Gomez, C.M., Lago, M., Maziotis, A., Rouillard, J., Strosser, P. (2013) *Design and Development of Economic Policy Instruments in European water policy*, FEEM project. http://www.feem-project.net/epiwater/docs/epi-water_guidance_v2.pdf

commodity can limit the access of poor actors. Most importantly, however, a successful trading system requires a functioning resource market with strong administrative and regulatory background, data availability, and a high level of transparency to ensure that all transaction are carried out correctly and enforced.

The European Union Emissions Trading Scheme was the first large greenhouse gas emissions trading scheme in the world and is currently in its 3rd trading period (2013-2020). It covers over 11,000 factories, power stations, and other installations in 31 countries, which in 2008 were collectively responsible for over 40% of the EU greenhouse gas emissions. The price of EU ETS carbon credits has been lower than intended, with a large surplus of allowances, partly due to the 2007-2009 economic crisis. The EU ETS has been characterized by policy uncertainty, limiting its success.[80]

No green tradable permit system of this size has been applied in the Arab region yet. However, voluntary tradable permit systems exist in some Arab countries like Morocco, Jordan, and Oman. In Oman the Aflaj water systems (mostly underground water channels that deliver renewable water by gravity), was originally built by farmers to irrigate fields and supply water to villages for household use. The system still provides a large part of water for irrigation in the country and is maintained by the users. As the water approaches each village, it emerges from these underground tunnels, where distribution of water is arranged as follows: For the first 50 meters, access to water is free for all.

The water is then delivered to the local mosque, and cabins for basic hygiene. Subsequently, schools have their water share allocated to them. From this point on, water becomes private property. Farmers get a water share equivalent to the investment in building the scheme. The allocated water entitlements are defined in terms of time, are tradable, and can be permanently sold or rented out for a limited period. The market price depends on when and where the water is made available. The money remains within the community. Creating a price for water amongst the farmers is an innovative way to enhance water efficiency, productivity,

Figure 7. Open Channel of Falaj Daris passing through a palm plantation in Al-Alaya quarter in Nizwa, Oman

Source: Fairouz Megdiche-Kharrat, April 2012

[80] European Commission, *The EU Emissions Trading System*, Retrieved 26 October 2016. http://ec.europa.eu/clima/policies/ets/index_en.htm

and sustainability. Typically, these farmers extract the highest possible value from their production per drop of water used. [81, 82]

4.7. RESEARCH AND DEVELOPMENT

Research and development is a non-appropriable, public good, involving risk and uncertainty due to asymmetries of information between capital markets and R&D investors. Public spending for research and development is important to fill the gap in private investment in research, protect public interests and meet society's needs such as a clean environment. It is thus an effective means of stimulating innovation and adaptation of green technologies to the local contexts.[83] Careful implementation should be exercised so as not to drive private funding away.

The Arab region contributed merely 1 per cent of global spending on research and development in 2013, which equates to 6 per cent of the total region's GDP. Several countries have announced plans to increase research spending to 10 per cent of GDP in the coming years.[84] Arab states are taking some steps, including launching a joint initiative to harmonize university curricula with their economies' needs and establishing an observatory of Science and Technology of the Arab region through joint work between the Arab League's Educational, Cultural, and Scientific Organization (ALESCO) and UNESCO. [85]

A strategic investment in R&D, ICT infrastructure, and technology transfer to transform the economic model in the Arab region is also needed to promote green innovations and achieve SGDs. For this to happen, a combination of factors, including a critical mass of scientists and regional research groups, is required to bridge the gap of knowledge and innovation in the Arab region. In addition to that, Arab brain regain is crucial to build science and technology base in the region learning from the successful examples of India and China which benefitted from brain regain and circulation of talents in the diaspora.

4.8. PUBLIC-PRIVATE PARTNERSHIPS

[81] Temporary Water Markets in Oman, Retrieved 15 June 2017:
https://www.researchgate.net/publication/235980813_Temporary_Water_Markets_in_Oman
[82] Abdel Rahman, H., Omezzine, A. (2009) *Aflaj Water Resources Management: Tradable Water Rights to Improve Irrigation Productivity in Oman, Water International*, Pages 70-75
[83] Bushehri, F. (2012) *Green Economy in the Arab Region*, presentation during TEEB Capacity-building Workshop for MENA Region.
https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf
[84] UNESCO (2016) *More Arab countries are seeking to orient their economies towards knowledge*, 20 May 2016.
http://www.unesco.org/new/en/member-states/single-view/news/more_arab_countries_are_seeking_to_orient_their_economies_towards_knowledge/#.WAQTePl9600
[85] UNESCO, www.unesco.org/fileadmin/MULTIMEDIA/HQ/SC/.../sc_usr10_arab_states_EN.pdf retrieved on 20.5.2017

A public-private partnership (PPP) is a government service or private business venture that is funded and operated through a partnership of government and one or more private sector companies. PPPs involve a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical, and operational risk in the project. PPPs can offer better infrastructure solutions, have greater return-on-investment because of innovative design and financing approaches, and assess and mitigate risks earlier. In principle, PPPs contribute to reducing government spending, lower taxes, and increased quality standards. There are risks associated with the adoption of PPPs, cost-effectiveness will suffer if faced with limited competition. Building on experiences of public-private partnerships in Europe, private companies involved in PPPs for public good services, such as water, did not provide the most sustainable service possible. Finally, when the government or regulator does not have necessary expertise to accurately set the contracts, assess the costs or operations, or monitor the operations of the private sector partner, cost-effectiveness is not guaranteed, and sustainability may suffer.

In the Arab region, PPPs have helped create alternative sources of funding and allowed for a greater flow of technical assistance to the region. While PPPs exist in nearly all Arab countries, so far, the Arab region had fewer infrastructure projects than other developing regions. Most of the projects are in the telecommunications and energy sectors.[86] International schemes, such as the Green Growth Fund, facilitate PPPs through offering a layered risk and return structure. The Fund aims to enhance energy efficiency and foster renewable energies predominantly through the provision of dedicated financing to businesses and households via partnering with financial institutions and direct financing. Target countries include Egypt, Jordan, Lebanon, Morocco, Tunisia and Palestine.[87] When engaging in public-private partnerships, ensuring adequate and independent oversight capacity by the public entity, as well as ensuring a participatory approach and guaranteeing access to information, transparency and accountability are of crucial importance for the success of the partnership and sustainable resource management.

In Egypt, the Egyptian Refining Company (ERC), a state-of-the-art refinery in the Greater Cairo area, is an example of public-private partnership that responds to an economic need while generating considerable social and environmental benefits. The InfraMed Infrastructure Fund, has invested USD 100 million in a US$ 3.7 billion worth ERC with the aim to reduce Egypt's current diesel imports by more than half and produce over 4.2 million tons of refined products and high-quality oil derivatives per year, including 3 million tons of jet fuel and Euro V diesel. The project's environmental benefits include eliminating about 93,000 tons of sulfur emissions annually and

[86] UN ESCWA (2013) *Public-private partnerships for infrastructure development in the Arab Region*, https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/public-private-partnerships-infrastructure-development-arab.pdf
[87] Sedaoui, R. (2016) *Energy Efficiency in the industrial sector*, International Beirut Energy Forum 2016. http://www.beirutenergyforum.com/p16/Day%202/Session%204/GGF%20Advancing%20Energy%20Efficiency%20&%20Renewable%20Energy.pdf

reducing SO_2 emissions by 29.1%. Moreover, ERC will lead to an estimated US$ 300 million in annual savings and revenues to state resources, as its contractual agreement states that the Egyptian General Petroleum Corporation (EGPC) will purchase all of ERC's production of high-quality fuel products. An Environmental/Social Impact Assessment (ESIA) was undertaken according to the standards of the International Finance Corporation (IFC) to minimize negative project impacts. Furthermore, producing in Greater Cairo reduces greenhouse gas emissions associated with transportation as well as transportation loss, a common problem associated with the transport and storage of petroleum products. From a socio-economic perspective, the project will create 700 permanent jobs and an additional 10,000 during the construction phase, will provide training for over 2,000 community members at the Welding Training Center, and a number of strategic community upgrading projects will also be undertaken based on a needs assessment.[88] Preliminary information on the progress of the project indicated that the ERC is more than 91% completed and that most of the objectives with regards to job creation and extended social responsibility have been met.

5. FINANCING INSTRUMENTS

Green technologies require up-front investment in technology and capacity building. The Arab region has limited access to capital, and technology and huge capital competing demands. According to the UN Technology Facilitation Platform's recent technology mapping, certain goals of the SDGs received substantial financial contributions and attention from governments and the private sector alike, such as for instance goals related to health and energy. Other goals however, for example goals relating to water, climate, oceans, and biodiversity received significant funding from international organizations but very low private sector investment and modest governmental support. This highlights an opportunity for private sector involvement in these areas that represent sustainable development challenges in Arab Countries.

Various types of financing instruments exist for different stages of technology development, including the early research and development phase, the industrial phase where businesses develop the technology at market scale or invest in technologies to green their business operations, and finally for end-users.

5.1. VENTURE CAPITAL

Venture Capital offers (green) entrepreneurs seed and growth capital to grow their businesses. Venture Capital firms in the region are steadily increasing to over 100 and play an important role

[88] EFG HERMES, *Sustainability Report*, 2014

in stimulating innovation, specifically in the United Arab Emirates, Egypt, Lebanon, Jordan, Saudi Arabia, Morocco, Kuwait, Palestine, Algeria, Tunisia and Bahrain.

Wamda is a platform of integrated programs that aims to accelerate entrepreneurship ecosystems throughout the Arab region with their base in Dubai and offices in Jordan and Lebanon. Its core focus includes media, community development, in addition to research and corporate and government advisory services. Wamda Capital's first fund of $70 million, launched in 2015, invested in 22 technology-centered startups, including Careem, The Luxury Closet and Mumzworld. Investors in the fund include Abraaj Group, Zain Group and International Finance Corporation.

5.2. BUSINESS INCUBATORS AND ACCELERATORS

Business incubators and accelerators offer financial support along with incubation and training services. Examples of incubators that promote young entrepreneurs include Oasis 500 in Jordan, SpeedStartup in the UAE and Flat5Labs in Cairo.[89] Accelerators in the region often adopt a model similar to Y Combinator, a seed accelerator, where companies receive seed money, advice, and connections in exchange for equity.

In Lebanon, Berytech provides entrepreneurs with support programs and events responding to different developmental stages of growing companies, in collaboration with a qualified team and professional experts. Agrytech an agri-food innovation hub developed by Berytech, offers interested entrepreneurs innovation tools for early stage support and provides competitions, office space hosting, acceleration and incubation as well as advice on commercialization, access to funding and scaling up to an international scale.[90] Berytech also runs an estimated $50 million capital venture fund.

5.3. MICROFINANCE

Microfinance can play a role in reaching rural populations, which currently lack access to electricity, clean water and cleaner fuels for cooking, biofuels, and low-emissions agriculture. Microfinance institutions offer financial services to low income populations in the form of loans, insurance, deposits along with other services.[91]

[89] Arab News, http://www.arabnews.com/role-startup-accelerators-incubators-and-social-media-promoting-entrepreneurship, retrieved 23.4.2017

[90] Ramy Boujawdeh, deputy GM, Berytech, 2017, *"Steps to support innovation in green technology in Lebanon"* presented at ESCWA Expert Group Meeting, https://www.unescwa.org/events/EGM-green-technologies-science-policy-interface, retrieved on 23.5.2017

[91] World Bank (2013) *Report on Advisory Services Operations in the Middle East and North Africa*, 2013, http://blogs.worldbank.org/arabvoices/boost-microfinance-arab-world, retrieved on 17.5.2017

Microfinance operations are taking place in Egypt, Morocco, Tunisia, Palestine, Jordan, Yemen, Lebanon and Iraq amongst others. Penetration of microfinance is still small, lending to 1.8 percent of the adult population. However, limited microfinance outreach in the region can be mainly attributed to lack of supporting regulation, underdeveloped financial infrastructure, and low levels of financial literacy among potential beneficiaries.[92]

In Morocco, the association Al Amana for the Promotion of Micro-Enterprises Morocco is a considered a successful microfinance institution registered as a non-profit organization in Morocco. Starting in 1997, with capital provided by USAID, it has grown to become the leading Microfinance Institution in Morocco and the broader Arab region. It has seen rapid growth in clients and assets while reaching a high level of financial sustainability. The Association provides loans up to 5,000 USD to more than a million beneficiaries, of which around 60% are women. The repayment rate of the loans is 99%. Al Amana Microfinance offers financial products such as solidarity-loans, business loans, housing loans, to improve living standards, and enhance access to electricity or drinking water.[93]

5.4. CENTRAL BANK LOANS

Central Bank loans create low interest scheme loans for environmentally friendly projects such as renewable energy, waste management and water treatment. They are available for businesses that develop green technologies as well as those that invest in greening their operations.

The Arab Monetary Fund facilitates increased coordination between the Finance Ministers of Arab countries and the exchange of experiences in the field of fiscal policies amongst others. It provides capacity building to member countries for economic reforms, enabling a conducive environment for small and medium enterprises, enhancing financial inclusion in the Arab countries.[94] It

The example of the Central Bank of Lebanon (Banque du Liban, BDL) provides a good example for the region through several initiatives:

- The National Energy Efficiency and Renewable Energy Action (NEEREA) is a green financing mechanism providing zero interest long-term loans in collaboration with the European Union (EU). It also introduced new incentives to focus on energy efficiency, renewable energy, and certified green buildings.

[92] Ibid.
[93] UNIDO (2009) *Investing and financing green business*, Arab Regional Program, UNIDO, background paper 2009
[94] Arab Monetary Fund (2017) *The Role of the Arab Monetary Fund in Achieving Sustainable Development Goals*, 2030, http://www.amf.org.ae/en/content/arab-monetary-fund-releases-new-publication-highlighting-its-efforts-achieve-sustainable, last accessed 17.10.2017

- The Lebanese Environmental Action (LEA) BDL offers subsidized loans for projects dealing with air quality, water, and the environment.
- BDL works with the Lebanese Center for Energy Conservation (LCEC) to encourage commercial banks to provide engineering firms with loans maturing in 12-14 years at interest rates as low as 1% and an initial grace period.

The Central Bank of Jordan (CBJ) supported an agreement between JREEF, Ministry of Energy, commercial banks, and Loan Guarantee Corporation to finance renewable energy projects. The agreement will also help provide necessary funds to individuals and small and medium-sized enterprises, with a focus on the industrial and tourism sectors against low interest rates with relatively long maturity.

5.5. LOAN GUARANTEES

Loan guarantees help emerging technologies take on debt with government backstop to the debt. Loan guarantees are a combination of cash and tax-like incentives, such as tax credits. If a government announces that it will pursue an environmental policy over a certain period, this sends a signal to private investors that it is safe to commit capital. In the Arab region, governments should play a catalytic role in coordinating partners, setting agendas, and underwriting initial capital needs to establish credibility to support debt guarantees for innovation.[95]

Tunisia through its Prosol Programme mentioned earlier, removed debt default risk from suppliers of solar water heaters. Commercial banks provided loans to customers through accredited suppliers which were repaid through customers' electricity bills. Customers' services were withheld if defaulted. The state utility acted as debt collector, enforcer, and loan guarantor, shifting the credit risks from lenders to borrowers. This has improved awareness and expertise of commercial banks for renewable energy lending.[96]

5.6. EQUITY-LINKED FINANCING

[95] Roper, S. *Credit Guarantee Schemes: a tool to promote SME growth and innovation in the MENA Region*, Warwick Business School, Retrieved 30 June 2017. https://www.oecd.org/mena/competitiveness/43982478.pdf

[96] World Economic Forum (2013) *The Green Investment Report – The ways and means to unlock private finance for green growth*, A Report of the Green Growth Action Alliance. http://www3.weforum.org/docs/WEF_GreenInvestment_Report_2013.pdf

Equity-linked financing consists of supply of risk capital for green technology through equity and debt finance.[97] Rather than providing subsidies, governments will have a direct financial stake in the supported firms. With the rising need to finance mega renewable energy projects via low-cost alternatives to traditional bank financing, green bonds and sukuk provide a plausible investment solution, especially in GCC countries. Green sukuks can be used to finance both, the region's ambitious renewable energy and infrastructure projects and the rising number of clean energy initiatives throughout the GCC and the region.[98]

In 2012, the Climate Bonds Initiative (CBI), the Clean Energy Business Council of the Middle East and North Africa (MENA), and the Dubai-based Gulf Bond & Association established the Green Sukuk Working Group to promote the idea of green sukuk which meets a low-carbon criterion environmentally sound standard. In 2015, the UAE issued the world's first green sukuk to finance green energy projects.

5.7. INTERNATIONAL FUNDING MECHANISMS

The Green Climate Fund was established by 194 governments to limit or reduce greenhouse gas emissions in developing countries, and to help adapt vulnerable societies to the unavoidable impacts of climate change. The Fund is a unique global initiative to respond to climate change by investing into low-emission and climate-resilient development.[99] The Arab region is strongly affected by climate change but has so far benefitted the least from green finance, mainly due to lack of preparedness Through establishment of Nationally Designated Authorities, these authorities can facilitate and oversee the fund's activities, raise awareness about the fund, provide capacity building on funding proposals, carry out priority and project identification, enable the private sector to become active, as well as set monitoring and review mechanisms.[100]

In the future, incentives for green technologies in the Arab region are likely to include climate and green funding and certification mechanisms. In the GCC, investment in green technology is expected to increase over the next five years due to the large-scale government plans and budget allocation for green technology programs that will attract private investors. In other countries in the region, investment in green technology is hindered by budget limitations and high risks for

[97] OECD, *Green technology and innovation*, Retrieved 26 October 2016. https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/newchallenges/greentechnologyandinnovation.htm
[98] http://meglobaladvisors.com/financing-a-greener-world-through-green-bonds-and-sukuk/, retrieved on 24.4.2017
[99] Green Climate Fund, http://www.greenclimate.fund/home, retrieved on 05.11.2017
[100] Richard, F., Capdeville, S. (2016) *Introduction to the Green Climate Fund,* Rabat.

international investors. Therefore, investment is expected to remain low and will come from international donors.[101]

6. CREATING AN ENABLING ENVIRONMENT FOR GREEN TECHNOLOGIES

Desk research reveals that many Arab countries have established laws to protect the environment, regulate the use of natural resources, or mitigate the effects of pollution along with legal texts that promote the use of green technologies. However, evidence for legal frameworks that comprehensively approach and promote the adoption of green technologies across all sectors in Arab countries is currently missing.[102] Arab countries continue to suffer from insufficient government policy frameworks and regulations which continues to represent the largest barrier to green technological growth across the region.[103]

Green technology needs to become an integral part of sectoral development strategies. At the same time, policy regimes should remain somewhat flexible and focus on environmental outcomes, thus allowing firms to identify the best ways to meet the environmental objectives rather than prescribing pollution abatement methods which would limit the incentive for innovation.[104]

Environmental policies and regulations should be designed with the following criteria:

- Appropriateness: policies should recommend solutions that are adapted and appropriate for the specific circumstances and priorities of the country.
- Efficiency: to ensure that social benefit is higher than the social cost of a regulation
- Cost-effectiveness means that an environmental target is reached with the least cost
- Fairness requires the policy makers to ask how the costs and benefits of the policy are distributed among income classes, races, geographical locations and industries
- Enforceability/possibility for implementation: policies should be realistic and their implementation possible

[101] Ernst and Young (2015) *MENA Cleantech Survey Report,* 4th Edition. http://www.ey.com/Publication/vwLUAssets/EY-middle-east-and-north-africa-cleantech-survey/$FILE/EY-middle-east-and-north-africa-cleantech-survey.pdf, retrieved on 19.4.2017

[102] Reference made to the Egyptian environmental law, the Lebanese environmental law, and the Moroccan environmental law; and in part to the GCC environmental cooperation

[103] Ernst and Young (2015) *MENA Cleantech Survey Report*, 4th Edition. http://www.ey.com/Publication/vwLUAssets/EY-middle-east-and-north-africa-cleantech-survey/$FILE/EY-middle-east-and-north-africa-cleantech-survey.pdf, retrieved on 19.4.2017

[104] UN ESCWA (2015) *Role of Technology in Sustainable Development in the Arab region*, Expert report for the Arab Sustainable Development Report, http://css.escwa.org.lb/SDPD/3572/5-Technology.pdf

Costa Rica had the highest deforestation rates in the world 20 year ago, but committed to reversing the trend of environmental degradation. Since, it has pursued green growth through a dedicated strategy, outlining the action plan towards carbon neutrality. In line with this strategy, the government announced its intention to become the world's first Carbon neutral country through "budgeting, laws, and incentives, including measures to promote biofuels, hybrid vehicles, and clean energy"[105]. The government charges voluntary taxes on tourists and businesses to fund the reforestation, conservation, and research in protected areas[106]. Costa Rica adopted Payments for Ecosystem Services in which the government pays farmers and landowners a lump sum amounts for forest or land that they "conserve, rehabilitate or regenerate, and the environmental services that these conserved lands provide"[107]. The Payment for Ecosystem Services scheme was funded through a fuel tax, water tax, funding from bilateral and multilateral agreements, and private donations. Small-scale farmers were also considered through the PSA Solidario program, where small-scale farmers can earn carbon credit through their protection of forests and sell it to national industries[108].

6.1. INDEPENDENT, EFFECTIVE AND RELIABLE REGULATORY AND INSTITUTIONAL FRAMEWORKS

Reliable regulatory and institutional frameworks that facilitate green economic activities while protecting the environment are crucial factors for businesses when making decisions on investments and operations.[109] Unanticipated changes in policy parameters force businesses to adjust, creating associated costs to comply with the new policies and potentially rendering previous investments obsolete. Such unpredictable policy changes drive away investors since it creates uncertainty.[110] Environmental regulations are often perceived as harmful for businesses. However, they can be drivers of domestic demand for green technologies if businesses are given sufficient timeframe associated with capacity building.[111]

Providing such a framework and its implementation also requires an independent regulatory body with clear responsibilities to set prices and hold specific entities accountable for the delivery

[105] World Watch Institute, *Costa Rica Aims to Become First 'Carbon Neutral' Country*, Retrieved 26 October 2016. http://www.worldwatch.org/node/4958
[106] Ibid
[107] International Institute for Sustainable Development (iisd). Pol*icy Tools That Support Transition Into a Green Economy*. September 2013. https://www.iisd.org/sites/default/files/publications/policy-tools-transition-green-economy-financing.pdf
[108] Ibid.
[109] Bushehri, F. (2012) *Green Economy in the Arab Region*, presentation during TEEB Capacity-building Workshop for MENA Region. https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf
[110] OECD, *Green technology and innovation,* Retrieved 26 October 2016. https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/newchallenges/greentechnologyandinnovation.htm
[111] Wess (2011) *National Policies for Green Development,* Chapter 5 in World Economic and Social Survey 2011. http://www.un.org/en/development/desa/policy/wess/wess_current/2011wess_chapter5.pdf

of efficient and affordable services. Monitoring emissions and collecting taxes to enforce permits is challenging to implement. There is no universally correct choice of instruments for managing a nation's environment. All policy instruments require monitoring capability, enforcement and control of corruption.

Finally, policies for innovation and technology adoption need to be connected across sectors. The Arab region ranks low on the Global Innovation Index. Although some Arab countries incorporated innovation policies, these policies generally lack connection to national development strategies. UN ESCWA proposed a framework for Innovation Policy in the Arab countries which includes setting up an innovative national vision, and enhances the four pillars for innovation improving education and training, strengthening research and development, consolidating regulatory frameworks, and supporting innovators.

Several countries have implemented policies to reduce waste, in particular plastic bags, through providing a clear policy framework. An awareness campaign about the death of camels and sea turtles after consuming plastic bags in the UAE led to increased public concern. According to Environment Agency of Abu Dhabi, around half of camel deaths in the UAE were considered attributable to plastic bags they had ingested. A survey conducted by the Ministry of Environment and Water found that 11.6 billion plastic bags were used annually in the country, of which 53.3% were non-biodegradable. The survey also found that plastic bags and other plastic material consisted of 10.9% of the total household waste. As a response, the Ministry launched the UAE Free of Plastic Bags initiative in October 2009, with the aim to reduce the quantity of plastic bags gradually towards the final prohibition and replacement with biodegradable plastic and other long lasting, reusable bags. The initiative was rolled out in four phases, including awareness raising and providing alternatives, and at the end of 2012, the ministry issued a decree banning the use of non-biodegradable plastic bags. Manufacturers and suppliers of plastic bags now must register their biodegradable products in

Figure 8. Recycling bin in Abu Dhabi

Source: http://bit.ly/2lbFsG4

accordance with the Emirates Conformity Assessment System (ECAS) and must meet the requirements and conditions listed in the UAE standard specifications (5009:2009).

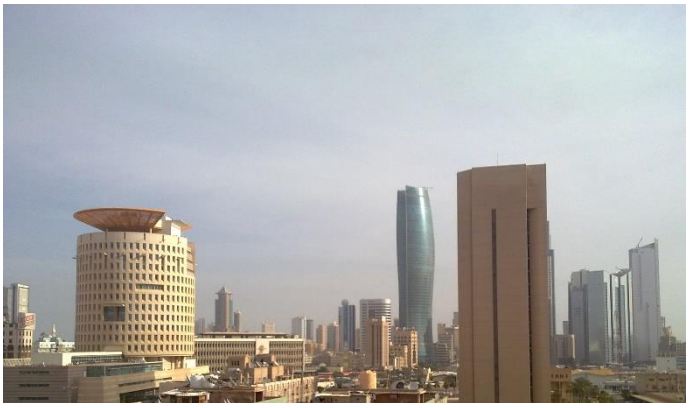
Regional policy frameworks can also help drive national policies in the Arab region. The Arab Strategy for Water Security 2010-2030 and its action plan, which includes an Integrated Arab Water Information System and the development of scientific research and technology transfer, are key policy documents adopted by the Arab Ministerial Water Council of the League of Arab States in 2011 and 2014 respectively.[112] However,

funding is lacking for the Strategy to drive green technology adoption and incentivize sustainable water management.

6.2. CODES AND STANDARDS

The development of codes and standards often lags behind the development of technologies. It also takes a long time to adopt and modify standards, which becomes a barrier for technological innovation. Most governments in the Arab region agree on the importance of formulating standards and adopting them to national condition; however, not all Arab countries have independent standard-setting authorities. For instance, minimum building and equipment efficiency standards are cost-effective approaches to save energy.

Figure 9. Kipco Tower, Kuwait city



Source: https://goo.gl/images/bD19a8

In 2010, Kuwait revised its version of the energy conservation code, which provided an estimated additional 23% savings compared to the original version of the code developed and implemented in 1983. The achieved savings were realized by making original energy conservation measures more stringent and, in some cases, mandatory, including improving building design, using efficient A/C systems, using energy recovery systems, making thermal insulation of exposed columns and beams mandatory, specifying maximum glazing-to-wall area ratios for each class of glazing, requiring thermal breaks for window frames to prevent thermal bridging, making

[112] UN ESCWA and UNEP (2015) *Arab Sustainable Development Report*, First Edition, 2015. https://www.unescwa.org/publications/arab-sustainable-development-report-2015

clear recommendations for the application of programmable thermostats, and using efficient lighting and appliances.[113]

Many countries developed sustainable building codes including building rating systems to encourage developers to abide by certain sustainability settings.

The United States Green Building Council (USGBC) developed the LEED certification program, now applied all over the world. It takes into consideration dimensions of sustainability in building design, including the choice of the building location, exhaustion of resources, emissions, and choice of appliances. Specific measures include intelligent lighting systems, natural ventilation, or clean energy-powered heating/cooling systems.

Qatar's Global Sustainability Assessment System is considered one of the comprehensive green building rating systems, while Abu Dhabi's Pearl Rating System has carved a niche of its own in global green buildings sector. Lebanon and Egypt also invested in green buildings and large-scale green projects are planned in the next years.[114]

Saudi Arabia has established many environment-friendly buildings, inspired by traditional architectural concepts, to pave the way for future architectural achievements. King Abdullah University of Science and Technology (KAUST) is considered as a model building with innovative designs including the following:

- Natural solar lighting, reducing the need for electrical lighting inside;
- "Solar cooling" through solar towers retaining solar heat and hot air to facilitate air movement in buildings and therefore reduce the need for electrical cooling; and
- Solar power which saves annual energy costs by 27.1 per cent. [115]

Figure 10. KAUST Laboratory buildings

Source: https://goo.gl/images/WmtD1Q

To support similar initiatives, Saudi Arabia developed energy efficiency codes originally introduced on voluntary basis in 2009 and became mandatory in 2010 for new government buildings. The code covers the building's energy systems including the envelope, mechanical,

[113] UN ESCWA (2014), *Promoting energy efficiency investments for climate change mitigation and sustainable development, case study: Kuwait.*
[114] Katkhuda, N. (2015) *Green Buildings and the Middle East*, EcoMENA, Echoing Sustainability. http://www.ecomena.org/tag/green-building-trends-in-middle-east/, retrieved on 22.5.2017
[115] KAUST, www.kaust.edu.sa, retrieved on 11.11.2017

electrical, lighting, and domestic hot water systems, with both prescriptive and performance compliance options. Moreover, new minimum energy performance standards (MEPS) were issued in 2012 for air conditioners, including both window and split type. In September 2013, the Saudi Standards, Metrology and Quality Organization (SASO) stopped issuing licenses for non-compliant units.[116] Saudi Arabia also introduced the Corporate Average Fuel Efficiency standard (CAFE) in 2014, with which light-duty vehicle (LDV) manufactures with sales in Saudi Arabia must comply. The application of this standard incentivized manufacturers to update to efficient technologies and promote the use of energy efficient LDVs over energy intensive ones. This is expected to increase the fuel efficiency of LDVs from its current level of 12 km per liter to 19 km per liter by 2025, and accordingly incentivize people to buy them. Currently there are 7 million LDVs entering the market every year with a forecast to reach 20 million by 2030. This will achieve many benefits such as enable consumers to save money, reduce fossil fuel consumption, and address climate change issues in the country. While the standard took effect in 2016, an impact study has not yet been conducted.[117]

6.3. CAPACITY BUILDING AND COOPERATION

The Arab region is faced with many challenges related to governance, knowledge, research and development, infrastructure, technological readiness, and regional cooperation. Challenges related to institutions can be addressed through capacity building and development among other measures. Public sector staff will benefit from training and awareness on the importance of inter sectoral coordination to avoid working in silos, and to ensure mainstreaming sustainable development principles. However, capacity development extends beyond public servants to include other sustainable development stakeholders. Applying a participatory approach for policy design as well as gathering regular feedback is an essential factor to increase buy in and ownership of the population of the policy decisions made. To nurture and enhance capacity to generate green technology, all relevant parties in the educational system, community, research and development and technology transfer offices, NGOs, industry, business parks, incubators, regulators, and financing institutions need to work in an integrated manner.

Berytech, a previously mentioned accelerator and incubator, is also active in capacity building and awareness raising, particularly on solar energy sector in the Mediterranean countries through one of its international projects “SHAAMS”. The project promotes solar renewable technologies through capacity transfer on legal, regulatory, and financial issues, organizing entrepreneurship competitions for innovators, offering capacity building programs for engineers

[116] Kankana Dubey, Nicholas Howarth and Moncef Krarti, *Evaluating Building Energy Efficiency Investment Options for Saudi Arabia,* October 2016.
[117] International council on clean transportation (2014), Policy update, *Proposed Saudi Arabia Corporate Average Fuel Economy Standard for New Light-Duty Vehicles* (2016–2020)

and school students in the renewable energy field, and conducting awareness activities (earth hour, conferences, etc.) to promote renewable and solar energy.

In the UK, the Department for Environment, Food and Rural Affairs has set up a Farming Advice Service that helps farmers understand and meet requirements of greening their farms and water conservation.[118] In the region, such an extension service could provide guidance on key technological developments related to types of seeds, irrigation methodologies, fertilizers and other issues related to addressing water scarcity and land aridity.[119]

Moreover, cooperation and participation across sectors, Ministries, and between countries is crucial for the success of any policy

Currently, UN ESCWA, in cooperation with Abu-Ghazaleh & Co. Consulting and AIDMO jointly work on promoting the adoption and application of an emerging nanotechnology in the Arab region to solve pressing needs in renewable solar energy and water desalination It offers a platform where national and regional partners and stakeholders from different sectors can meet and exchange research opportunities support technology transfer, and discover business opportunities. Another UN ESCWA green initiative aimed at strengthening national capacities for developing green production sectors and established Green Help Desks in six countries (Lebanon, Oman, Jordan, Egypt, Tunisia and Morocco). The Green Help Desks provide support to small and medium enterprises engaged in green processes. They provide information dissemination services, along with networking and training.

7. CONCLUSION

The Arab region still lags behind in the development of green technology and more efforts are needed to prepare the ground for such a path. Given the recent shift towards green technologies to achieve the 2030 Agenda for Sustainable Development, it is indispensable for governments to set out on the path of promoting green technology use in their countries.

The Arab region, with its current constraints, may initially focus on reaping the low-hanging fruits, implementing low-cost and efficient measures to grow its economy and address poverty and unemployment while preserving its resources. Governments may commence with green public procurement processes, and setting codes and standards for resources' efficiency, including building codes given the large construction sector in many Arab countries. The region will also benefit greatly from reforming its institutional framework to be better prepared for a transition to a greener economy.

[118] DEFRA, *Farming Advice Service*, https://www.gov.uk/government/groups/farming-advice-service
[119] Bushehri, F. (2012) *Green Economy in the Arab Region*, presentation during TEEB Capacity-building Workshop for MENA Region. https://www.cbd.int/doc/meetings/im/wscbteeb-mena-01/other/wscbteeb-mena-01-unep-green-economy-arab-en.pdf

To gain from the momentum created by Paris Agreement and the Addis Ababa Action Agenda, there is a need to strengthen collaboration with global and regional financial institutions and research and development centers including universities to provide support to entrepreneurs and innovators in green technology.

Various economic policies to promote the adoption of green technologies exist, and many were described in previous sections. On top of these policies, come the reforms to phase out environmentally harmful subsidies on valuable resources like water, energy and land, placing real costs in pricing natural resources including costs of environmental impacts. Taxation should be shifted towards pollution and resources to stimulate consumer interest towards resource-efficient products.

It is important to note that while the listed policies could help address environmental negative impacts, they often come at certain economic and social costs, which must be carefully assessed and balanced. Policy makers need to formulate specific strategies to ensure access to resources by the poor and disadvantaged households.

Moving towards a sustainable and green economy through the adoption of green technologies requires investment not only from the government but also from the private sector. Experiences from countries around the world demonstrate that stable policy and regulatory frameworks attract investors and enable a faster and more efficient transition towards green technology adoption.

Finally, the effective implementation of these economic policies requires strong political will, available and reliable data for evidence-based policy-making, monitoring and evaluation mechanisms, as well as the trust of all involved actors.

ANNEXES

ANNEX 1: TECHNOLOGY INCLUDED IN THE SDGS

SDG	Technology included in the SDGs
Goal 1	1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance
Goal 2	2.A Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks to enhance agricultural productive capacity in developing countries, in particular least developed countries
Goal 4	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship
	4.B By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries
Goal 5	5.B Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women
Goal 6	6.A By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
Goal 7	7.A By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
	7.B By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support
Goal 8	8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors
	8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services
Goal 9	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
	9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending
	9.A Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States
	9.B Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities

	9.C Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020
Goal 12	12.A Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
Goal 14	14.A Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
Goal 17	17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism
	17.7 Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed
	17.8 Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology
	17.16 Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries

ANNEX 2: FUEL SUBSIDY PHASE OUT IN ARAB COUNTRIES, 2011-2015

Country	Fuel subsidy phase out	Main Mitigating Measures	Next Steps
Egypt	**2012–13**: prices for 95 octane gasoline increased by 112 percent for high-end vehicles; fuel oil for non-energy-intensive industries by 33 percent and for energy-intensive industries by 50 percent. **July 2014:** fuel and natural gas prices increased by 40-80 percent.	Some additional social expenditure envisaged in the budget for the fiscal year 2014/15 to cover a higher number of beneficiaries of social security pensions.	Introduce further price increases with the aim of eliminating subsidies in five years.
Jordan	**November 2012**: elimination of fuel subsidies. **January 2013**: monthly fuel price adjustment mechanism resumed.	Cash transfers to families below a certain income threshold (70 percent of the population) if oil prices are above $100.	Diversify energy import mix and develop new energy sources with lower generation costs.
Mauritania	**May 2012**: new automatic diesel price formula introduced, bringing domestic fuel prices up to international levels. **August 2014**: gas prices increased—ranging from 15 to 50 percent. Another price hike is expected end-2014 to remove the gas subsidy	Gradual reorientation of social safety nets toward well-targeted cash transfer schemes, but progress has been very slow.	Ensure diesel pricing formula is applied automatically. Develop a nationwide cash transfer program that includes strengthening public sector governance in emergency response.
Morocco	**June 2012**: diesel prices increased by 14 percent, gasoline by 20 percent, and industrial fuel by 27 percent. **September 2013**: started implementation of a partial indexation mechanism of certain petroleum products. As a result, diesel prices increased by 8.5 percent, gasoline by 4.8 percent, and fuel by 14.2 percent. **February 2014**: gasoline and industrial fuel (excluding fuel used for electricity generation) subsidies eliminated, their prices are reviewed twice a month and reduction of the per-unit subsidy of diesel. **January 2015**: subsidy of diesel eliminated.	Gradual strengthening of the existing social safety nets and their targeting to vulnerable groups through improvements in education, health, and assistance to poor widows and the disabled. Supporting public transport.	Continue implementing the comprehensive subsidy reform (remaining products are butane gas as well as sugar and flour) combined with cash transfers and other social assistance programs.
Sudan	**June 2012**: gasoline, diesel, and liquefied petroleum gas prices increased by 47 percent, 23 percent, and 15 percent, respectively; jet fuel liberalized.	Public sector wage increase of about SDG100; a monthly grant allocation of SDG150 for about 500,000 urban poor families (end-2014 target);	Gradually phase out the remaining subsidies on petroleum products and other staples while strengthening the

	September 2013: diesel prices increased by 74.7 percent, gasoline by 68.0 percent, and liquefied petroleum gas by 66.7 percent.	lower health insurance premium for about 500,000 poor families; and an exemption of school and transportation fees for disabled people.	social safety net through higher social spending and a more coherent and better targeted social net.
Tunisia	**September 2012**: gasoline and diesel prices increased by 7 percent, on average. **March 2013**: further 7–8 percent price increase, on average for the same products. **January 2014**: energy subsidies to cement companies were reduced by half and then eliminated in June 2014. **July 2014**: gasoline prices increased by 6.4 percent and diesel prices by about 7 percent.	Creation of a new social housing program for needy families. Increase of income tax deduction for the poorest households. Increase and expansion of the cash transfers program for poor families.	Gradually phase out energy subsidies by increasing electricity tariffs and fuel prices. Continue expanding and improving the targeted household support strategy. Operationalize the unified registry system for vulnerable households.
Yemen	**2011–12**: gasoline prices increased by 66 percent and diesel and kerosene prices doubled. **2013**: diesel price unified across users, including the electricity sector. **June 2014**: private sector companies allowed to directly import diesel for their own use at international prices. **July-September 2014**: The prices of diesel and gasoline increased by 50 percent and 20 percent, respectively. These are net increases after the partial reversal of a larger adjustment introduced in July.	Increase in the Social Welfare Fund transfers to the poor by 50 percent in December 2014. Coverage of the Social Welfare Fund (SWF) was expanded to 500,000 additional families.	Adopt a fuel pricing mechanism that would allow domestic prices to move in response to increases in international prices. This will help reduce further energy subsidies. Strengthen support through an expansion of the SWF. Increase in infrastructure investment.
	Oil exporters		
Kuwait	**January 2015**: government raised diesel and kerosene prices (+50%) and instituted monthly price review mechanism.	n/a	n/a
Qatar	**May 2014:** Diesel prices up in May-14 by 50%. Starting to improve desalination technologies and awareness of sustainable energy use.	n/a	n/a
UAE	Gasoline price highest in GCC (still below international levels).	n/a	n/a

ANNEX 3: ECONOMIC INSTRUMENTS TO REDUCE ELECTRICITY CONSUMPTION IN SELECTED ARAB COUNTRIES

Country	Electricity tariffs	Main Mitigating Measures	Next Steps
Egypt	January 2013: electricity prices to households increased by 16 percent on average, natural gas and fuel oil prices for electricity generation rose by one-third. July 2014: electricity tariffs increased by 10-50 percent.	Electricity tariffs unchanged for the lowest consumption bracket.	Finalize the distribution of smartcards. Expand priority social programs and targeted cash transfer.
Jordan	June 2012: electricity tariffs increased for selected sectors (banks, telecommunications, hotels, mining) and large domestic corporations and households. August 2013 and January 2014: electricity tariffs increased by 7.5–15 percent for selected consumers. January 2015: electricity tariffs increased by up to 15 percent for selected consumers. In February 2015, the authorities repealed half of the 2015 electricity tariff increase.	Cash transfers to families below a certain income threshold (70 percent of the population) if oil prices are above $100.	Gradually increase electricity tariffs
Mauritania	January 2012: electricity tariffs increased for the service sector.	Gradual reorientation of social safety nets toward well-targeted cash transfer schemes, but progress has been very slow.	Eliminate electricity subsidy.
Morocco	June 2014: removal of subsidies on industrial fuel used for electricity generation.	Direct transfers to electricity company to last four years while measures are taken to ensure the financial viability of the company.	cash transfers and other social assistance programs.
Tunisia	September 2012: electricity tariffs increased by 7 percent on average. January 2014: Electricity tariff and natural gas prices increased for medium and low-voltage consumers with a 10 percent rate hike in January 2014 and May 2014.	Introduction of an additional lifeline electricity tariff for households consuming less than 100 kwh per month.	Gradually phase out energy subsidies by increasing electricity tariffs and fuel prices. Continue expanding and improving the targeted household support strategy. Operationalize the unified registry system for vulnerable households.

UAE	Abu Dhabi increased water (+170%) and electricity (+40%) tariffs in Jan-15.

Source: IMF (2014) Subsidy Reform in the Middle East and North Africa: Recent Progress and Challenges Ahead / Carlo Sdralevich, Randa Sab, Younes Zouhar, and Giorgia Albertin. International Monetary Fund, http://www.imf.org/external/pubs/ft/dp/2014/1403mcd.pdf, last accessed December 2017

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