Community Power Based Transition of Cities to 100 % Renewable Energy

Prof. Dr. Tanay Sıdıki Uyar
Head, Energy Section, Marmara University
President, Renewable Energy Association of Turkey (EUROSOLAR Turkey)

ENERGYPATH 2018: Grid Integration Conference
Desales University, Center Valley, PA USA 26 July 2018
Figure Legend:
Fig. 1. Geological time scale and development of oxygen in Earth’s atmosphere. BCE = before current era.
The Industrial Revolution Has Caused a Dramatic Rise in CO₂

Carbon Dioxide Variations

Year (AD)

CO₂ Concentration (ppmv)

Thousands of Years Ago
The Greenhouse effect

Solar radiation passes through the clear atmosphere.

Incoming solar radiation: 343 Watt per m²

Net incoming solar radiation: 240 Watt per m²

Outgoing solar radiation: 103 Watt per m²

Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.

Surface gains more heat and infrared radiation is emitted again

Solar energy is absorbed by the earth's surface and warms it...

168 Watt per m²

... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere

Some of the infrared radiation passes through the atmosphere and is lost in space

Net outgoing infrared radiation: 240 Watt per m²

Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.
Alliance of six institutions led by researchers at the University of Virginia are designing the world’s largest wind turbine.
Global Investment in New Power Capacity, by Type (Renewables, Fossil Fuels and Nuclear Power), 2017

- Nuclear power: 42 billion USD (9.2%)
- Fossil fuels: 103 billion USD (22.6%)
- Renewables (excluding hydropower >50 MW): 265 billion USD (58.2%)
- Hydropower >50 MW: 45 billion USD (10%)

Source: BNEF
Global New Investment in Renewable Energy by Technology in Developed, Emerging and Developing Countries, 2017

<table>
<thead>
<tr>
<th>Technology</th>
<th>New Investment in 2007 (Billion USD)</th>
<th>Change relative to 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar power</td>
<td>45.4</td>
<td>+18%</td>
</tr>
<tr>
<td>Wind power</td>
<td>52.4</td>
<td>-12%</td>
</tr>
<tr>
<td>Bio-power</td>
<td>2.3</td>
<td>-36%</td>
</tr>
<tr>
<td>Small-scale hydropower</td>
<td>0.2</td>
<td>-14%</td>
</tr>
<tr>
<td>Biofuels</td>
<td>1.7</td>
<td>-3%</td>
</tr>
<tr>
<td>Geothermal power</td>
<td>0.6</td>
<td>-34%</td>
</tr>
<tr>
<td>Ocean energy</td>
<td>0.2</td>
<td>-14%</td>
</tr>
</tbody>
</table>

Source: BNEF
Renewable Energy in Total Final Energy Consumption, by Sector, 2015

- **Heat**: 48%
  - 16.4% Traditional biomass
  - 27% Renewable energy
  - 1.9% Renewable electricity for heat

- **Transport**: 32%
  - 8.4% Modern renewables other than electricity
  - 2.8% Biofuels

- **Power**: 20%
  - 3% Renewable energy
  - 25% Renewable electricity

**Note:** Figures may not add up due to rounding.
Estimated Renewable Energy Share of Global Electricity Production, End-2017

73.5% Non-renewable electricity

26.5% Renewable electricity

16.4% Hydropower

5.6% Wind power

2.2% Bio-power

1.9% Solar PV

0.4% Ocean, CSP and geothermal power
Jobs in Renewable Energy

- **Bioenergy**: biomass, biofuels, biogas
- **Geothermal**
- **Solar energy**: solar PV, CSP, solar heating/cooling
- **Wind power**
- **Hydropower (small-scale)**
- **Hydropower (large-scale)**

= 50,000 jobs

8.8 million + 1.5 million

World Total: **10.3 million jobs**

Source: IRENA

**RENEWABLES 2018 GLOBAL STATUS REPORT**

Number of countries


Power: 128 countries
Transport: 70 countries
Heating & Cooling: 24 countries (29 countries had other heating and cooling policies)

Number of countries with power regulatory incentives/mandates
Number of countries with transport regulatory incentives/mandates
Number of countries with heating and cooling regulatory incentives/mandates

Source: REN21 Policy Database

REN21 RENEWABLES 2018 GLOBAL STATUS REPORT
Countries with Energy Efficiency Policies and Targets, End-2017

Source: REN21 Policy Database
Shares of Bioenergy in Total Final Energy Consumption, Overall and by End-Use Sector, 2016

- **Non-biomass**: 87.2%
- **Biomass**: 12.8%
- **Heat, buildings**: 7.8%
- **Heat, industry**: 2.2%
- **Transport**: 0.9%
- **Electricity**: 0.4%

### Breakdown by Sector

- **Traditional biomass**: 21.8%
- **Modern biomass**: 6.1%
- **Non-biomass**: 3.0%

**Heat, buildings**
- Traditional biomass: 21.8%
- Modern biomass: 6.1%

**Heat, industry**
- Non-biomass: 3.0%

**Transport**
- Non-biomass: 2.1%

Exajoules

EU-28 Total
3.6 Exajoules

Rest of EU-28
United Kingdom
Romania
Spain
Austria
Sweden
Poland
France
Finland
Germany
Biogas
Solid biomass
Municipal solid waste

REN21 RENEWABLES 2018 GLOBAL STATUS REPORT
Global Bio-Power Generation by Region, 2007-2017

555 Terawatt-hours

World Total

Terawatt-hours per year


Rest of World
China
South America
Asia
North America
EU-28
Global Trends in Ethanol, Biodiesel and HVO/HEFA Production, 2007-2017

HVO (hydrotreated vegetable oil) HEF (hydroprocessed esters and fatty acids)

Energy content (exajoules)

World Total
3.5 Exajoules

- HVO/HEFA
- Biodiesel (FAME)
- Ethanol
Figure 10: Some Conversion Pathways to Advanced Biofuels

<table>
<thead>
<tr>
<th>FEEDSTOCK</th>
<th>PRETREATMENT</th>
<th>INTERMEDIATE</th>
<th>CONVERSION</th>
<th>PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural residues</td>
<td>Pretreatment/Hydrolysis</td>
<td>C5/C6 sugars</td>
<td>Fermentation</td>
<td>Ethanol, butanol</td>
</tr>
<tr>
<td>Municipal wastes</td>
<td>Pyrolysis</td>
<td>Pyrolysis oil</td>
<td>Pretreatment and hydrogenation</td>
<td>Diesel jet fuel, gasoline</td>
</tr>
<tr>
<td>Forestry residues</td>
<td>Gasification</td>
<td>Syngas</td>
<td>Syngas fermentation</td>
<td>Methanol</td>
</tr>
<tr>
<td>Energy crops</td>
<td></td>
<td></td>
<td>Fischer-Tropsch</td>
<td>Mixed higher alcohols</td>
</tr>
</tbody>
</table>

REN21 Renewables 2017 Global Status Report

- Indonesia: 39%
- Chile: 7%
- Iceland: 6%
- Honduras: 5%
- Mexico: 4%

Remaining 4 countries:
- United States: 3.4%
- Japan: 0.7%
- Portugal: 0.6%
- Hungary: 0.4%
Geothermal Power Capacity and Additions, Top 10 Countries and Rest of World, 2017

- United States: 2,500 MW added, 2,524 MW total
- Philippines: 1,750 MW added, 1,775 MW total
- Indonesia: 1,530 MW added, 1,805 MW total
- Turkey: 1,243 MW added, 1,268 MW total
- New Zealand: 1,025 MW added, 1,050 MW total
- Mexico: 250 MW added, 255 MW total
- Italy: 45 MW added, 50 MW total
- Iceland: 45 MW added, 50 MW total
- Kenya: 5 MW added, 10 MW total
- Japan: 90 MW added, 95 MW total
- Rest of World: 24 MW added, 26 MW total
Hydropower Global Capacity, Shares of Top 10 Countries and Rest of World, 2017

- **28%** China
- **9%** Brazil
- **7%** Canada
- **7%** United States
- **31%** Rest of World

Next 6 countries:
- Russian Federation: 4.3%
- India: 4.0%
- Norway: 2.7%
- Turkey: 2.5%
- Japan: 2.0%
- France: 1.7%
Solar PV Global Capacity and Annual Additions, 2007-2017

World Total
402 Gigawatts

Source: IEA PVPS

Total global capacity

Annual additions
Previous year’s capacity

Source: REN21 RENEWABLES 2018 GLOBAL STATUS REPORT
Solar PV Global Capacity, by Country or Region, 2007-2017

World Total
402 Gigawatts

- Rest of World
- Italy
- Germany
- Japan
- United States
- China

Total global capacity

REN21
RENEWABLES 2018 GLOBAL STATUS REPORT
Solar PV Capacity and Additions, Top 10 Countries, 2017

Gigawatts

+53.1
+10.6
+7
+1.7
+0.4
+9.1
+0.9
+0.9
+1.3
+0.1

- **Annual additions**
- **Previous year’s capacity**
Solar PV Global Capacity Additions, Shares of Top 10 Countries and Rest of World, 2017

- **54%**  
  - China

- **9.3%**  
  - India

- **8.8%**  
  - United States

- **7.1%**  
  - Japan

- **10%**  
  - Rest of World

Next 6 countries:

- **Turkey**  
  - 2.7%

- **Germany**  
  - 1.7%

- **Australia**  
  - 1.3%

- **Republic of Korea**  
  - 1.2%

- **United Kingdom**  
  - 0.9%

- **Brazil**  
  - 0.9%

Gigawatts

World Total
4.9 Gigawatts

- Rest of World
- Spain
- United States

RENEWABLES 2018 GLOBAL STATUS REPORT

Total global capacity

- Glazed collectors
- Unglazed collectors

Source: IEA SHC
Solar Water Heating Collector Additions, Top 20 Countries for Capacity Added, 2017

China: +4% (Unglazed collectors)
Turkey: +26% (Glazed - evacuated tube collectors)

Other countries and their percentage changes:
- India: -3%
- Brazil: -3%
- United States: -4%
- Germany: -16%
- Australia: -3%
- Israel: +1%
- Mexico: +7%
- Greece: +16%
- Spain: -5%
- Italy: -4%
- South Africa: +4%
- Poland: -4%
- Taipei, China: -9%
- Austria: -3%
- Switzerland: -2%
- Tunisia: -15%
- Japan: -27%
Solar Water Heating Collectors Global Capacity in Operation, Shares of Top 12 Countries and Rest of World, 2016

- **71.2%** China
- **18.4%** Next 11 countries
  - United States: 3.9%
  - Turkey: 3.3%
  - Germany: 3.0%
  - Brazil: 2.1%
  - India: 1.5%
  - Australia: 1.4%
  - Austria: 0.8%
  - Israel: 0.7%
  - Greece: 0.7%
  - Italy: 0.7%
  - Japan: 0.5%
- **10.4%** Rest of World

Source: IEA SHC
Wind Power Global Capacity and Annual Additions, 2007-2017

World Total
539 Gigawatts

- Annual additions
- Previous year's capacity

Gigawatts

- 2007: 94
- 2008: 121
- 2009: 159
- 2010: 198
- 2011: 238
- 2012: 283
- 2013: 319
- 2014: 370
- 2015: 433
- 2016: 487
- 2017: 539
Wind Power Capacity and Additions, Top 10 Countries, 2017

Gigawatts

- China: +19.7
- United States: +7.0
- Germany: +6.1
- India: +4.1
- Spain: +0.1
- United Kingdom: +4.3
- France: +1.7
- Brazil: +2.0
- Canada: +0.3
- Italy: +0.3

Annual additions

Previous year's capacity
Wind Power Offshore Global Capacity by Region, 2007-2017

Gigawatts

- North America
- Europe
- Asia

2007: 1.1
2008: 1.5
2009: 2.2
2010: 3.2
2011: 4.1
2012: 5.4
2013: 7.0
2014: 8.7
2015: 12.2
2016: 14.4
2017: 18.8

REN21 RENEWABLES 2018 GLOBAL STATUS REPORT
Market Shares of Top 10 Wind Turbine Manufacturers, 2017

- Vestas (Denmark) 16.7%
- Siemens Gamesa (Spain) 16.6%
- GE (USA) 7.6%
- Goldwind (China) 10.5%
- Envision (China) 6.0%
- Enercon (Germany) 6.6%
- Others 19.6%

Next 4 companies:
- Nordex Acciona (Germany) 5.2%
- Mingyang (China) 4.7%
- Senvion (Germany) 3.7%
- Suzlon (India) 2.6%

Source: FTI Consulting
Share of Electricity Demand Met by Wind Power, Selected Countries with over 10% and EU-28, 2016
Conceptual Progression from the Baseload Paradigm to a New Paradigm of 100% Renewable Electricity
Conceptual Progression from the Baseload Paradigm to a New Paradigm of 100% Renewable Electricity

In the early stages of progression to larger shares of variable renewable generation, power systems make some adjustments in their grid operations, develop forecasting systems for renewable energy production, and introduce improved control technology and operating procedures for efficient scheduling and dispatch.

B) The Early Transition

<table>
<thead>
<tr>
<th>Power generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand shift</td>
</tr>
<tr>
<td>+ to early morning lows</td>
</tr>
<tr>
<td>Peak</td>
</tr>
<tr>
<td>Intermediate and dispatchable</td>
</tr>
<tr>
<td>Baseload</td>
</tr>
<tr>
<td>Variable renewable energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
</tr>
<tr>
<td>Oil</td>
</tr>
<tr>
<td>Diesel generator</td>
</tr>
<tr>
<td>Nuclear</td>
</tr>
<tr>
<td>Natural gas-fueled</td>
</tr>
<tr>
<td>Hydro-power</td>
</tr>
<tr>
<td>Bio-power</td>
</tr>
<tr>
<td>Solar-PV and CSP</td>
</tr>
<tr>
<td>Geothermal power</td>
</tr>
<tr>
<td>Wind power</td>
</tr>
</tbody>
</table>
Conceptual Progression from the Baseload Paradigm to a New Paradigm of 100% Renewable Electricity

In the late stages of progression towards fully renewable power systems, variable renewable power will be integrated through advanced resource forecasting, grid reinforcements and strengthened interconnections, improved information and control technologies for grid operations, widespread deployment of storage technologies, greater efficiency and scope of demand response, and coupling of electricity, heating and cooling, and transport sectors.

[Diagram showing power generation and energy sources]

- Over-production
- Storage or import/trade
- Dispatchable
- Variable renewable energy
- CSP with thermal energy storage

REN21 Renewables 2017 Global Status Report
GIVING THE RIGHT PRICE TO ENERGY PRODUCTION

External costs

Internal or private costs

Focus on EU 25, Bulgaria, Turkey, China, Brazil, India

NEEDS-IP and CASES-CA
Energy Scenario 2050
Primary Energy Consumption Covered

- Coal
- Oil
- Nuclear
- Gas
- Hydro
- Wind
- Solar
- Biomass

Energy savings & energy efficiency

100%
45%
EU Key Climate and Energy Objectives for 2020

- By 2020 -20% EU GHG
- By 2020 +20% ENERGY SAVING
- By 2020 binding 20% RENEWABLES in final energy consumption at EU level
  - RES in transport
    - Min 10% binding
  - ELECTRICITY
    - MS binding choice
  - HEATING & COOLING
    - MS binding choice
- NATIONAL TARGETS & ACTION PLANS
EU 2030 Framework for Climate and Energy

- **2020**
  - -20% Greenhouse Gas Emissions
  - 20% Renewable Energy
  - 20% Energy Efficiency
  - 10% Interconnection

- **2030**
  - \( \leq -40\% \) Greenhouse Gas Emissions
  - \( \geq 27\% \) Renewable Energy
  - \( \geq 27\% \) Energy Efficiency
  - 15% Interconnection

*To be reviewed by 2020, having in mind an EU level of 30%*

New governance system + indicators
Revolution Now
Accelerating Clean Energy Deployment

**Land-Based Wind**
Wind accounted for 31% of all new generation capacity installed in the U.S. from 2008 through 2014.

**Distributed Solar PV**
Over 8 GW installed by 2014, equal in capacity to 16 typical coal fired power plants.

**Utility-Scale Solar PV**
Grew by 68% in 2014 to 9.7 GW total—over 99% of this total has been installed since 2008.

**LEDs**
78 million total LED bulbs installed through 2014—a six-fold growth since 2012.

**EVS**
Nearly 300,000 EVs sold through 2014.

**Falling Costs for Clean Energy Technologies**
Indexed Cost Reductions Since 2008

**Deployment Sources:**
- GTM & SEIA. U.S. Solar Market Insight: 2014 Year-in-Review. March 2015. Assuming one coal plant is typically 0.5 GW.

**Cost Sources:**
- modeled batteries: Costs are modeled costs for high-volume battery systems, derived from DOE/US Advanced Battery Consortium PHEV Battery development projects.
RENEWABLE ENERGY STRATEGIES VANCOUVER
Elsystemet lige nu

Målt i MW:
- Centrale kraftværker: 1.396 MW
- Decentrale kraftværker: 414 MW
- Vindmøller: 3.768 MW
- Solceller: 0 MW
- Nettoudveksling eksport: 1.818 MW
- Elforbrug: 3.760 MW
- CO2 udledning: 197 g/kWh

IKONFORKLARING

Om Elsystemet lige nu

Jylland - Norge
Eksport: 953 MW

Jylland - Sverige
Eksport: 15 MW

Sjælland - Sverige
Eksport: 212 MW

Storebælt
579 MW

Jylland - Tyskland
Eksport: 159 MW

Sjælland - Tyskland
Eksport: 479 MW

Bornholm - Sverige
Import: 1 MW

Energy Storage Systems

- Batteries
  - Regular & Flow Systems
- Pressurized Systems
  - Compressed Air
- Kinetic Energy Storage
  - Flywheels (*magnetic propulsion*)
- Magnetic Energy Storage
  - Superconductors, Inductors
- Electric Energy Storage
  - Supercapacitors
- Gravitational Energy
  - Pumped Hydro Station
- Thermal Energy
  - Phase Changing Materials
- Chemical Energy
  - Hydrogen Energy Storage
Conventional Electricity Grid – Microgrid Systems
Community Microgrid System

- Distribution Transformer
- Isolating Device
- Power System Secondary
- Inverter
- DC Bus
- Fuel Cell
- Charge Regulator
- Energy Storage
- Heat Distribution
- Utility System Primary Connection
- Utility System Interface and Master Controller
- PV
- Thermal Storage
- House 1
- House 2
- House 3
- House 4
- House 5
ENERGY MIRACLE? SOLAR

Costs down 150x

Cumulative installations up 115,000x

Volume installed (MW) - RH scale
Crystalline silicon PV module price (2015 $/W(DC)) - LH scale
Solar Farm Costs Are Shrinking

The global weighted average of a utility-scale solar project is set to fall by 84 percent.

Source: IRENA analysis and Photon Consulting, 2016
Solar May Beat Coal in A Decade

Source: Bloomberg New Energy Finance
Note: Price in real 2016 dollars
Solar electricity for 2.5 cents
In many countries, photovoltaics could already be today’s most significant source of power – by simply being the least expensive
Prices of utility-scale solar PV in key markets

- United Kingdom: USD 0.093/kWh
- Germany: USD 0.080/kWh
- France: USD 0.089/kWh
- Jordan: USD 0.067/kWh
- United Arab Emirates: USD 0.030/kWh*
- Mexico: USD 0.045/kWh
- Brazil: USD 0.048/kWh
- Peru: USD 0.080/kWh
- Chile: USD 0.065/kWh
- South Africa: USD 0.075/kWh

*kWh = kilowatt-hour

* Bid price (rounded up from USD 0.0299/kWh; winning bid still undetermined at time of publication)
 „Energiewende“: A triple approach
100 measures in the three areas

1. Renewable energy sources:
   • Rapid, continuous expansion
   • Cost-efficient and environmentally friendly

2. Future grids:
   • Flexible and powerful
   • Integration of electricity from renewable sources

3. Efficiency:
   • Reduce energy consumption
   • Ensure efficiency
100% Renewable Energy is POSSIBLE

27-29 June 2013, İstanbul

IRENEC 2013
INTERNATIONAL 100 % RENEWABLE ENERGY CONFERENCE AND EXHIBITION

EUROSOLAR Turkey, the Turkish Section of European Association for Renewable Energies, in line with the vision of the Association, is organizing every year IRENEC, International 100% Renewable Energy Conferences, to set up an international platform to discuss the technical, economic, political aspects of transition to 100% Renewable Energy and build the courses to realize this vision in industry, architecture, transportation, local communities and training.

Following the paths to be set out in the conclusions of IRENEC 2012, the global challenge to transform totally the existing energy network for a 100% renewable energy future shall be the main theme of the topics of IRENEC 2013.

Contacts: info@irenec2013.com
www.irenec2013.com
T. +90 533 395 5809
TRANSITION TO 100% RENEWABLE ENERGY IS THE ONLY SOLUTION

EUROSOLAR Turkey, the Turkish Section of the European Association for Renewable Energy, once again brings you the annual International 100% Renewable Energy Conference (IRENEC 2014). As per the vision of the Association, IRENEC provides an international platform for the sharing of knowledge and ideas regarding the technical, economic, and political aspects of the transition to 100% Renewable Energy and for building the networks to realize this vision through industry, architecture, transportation, local communities and training.

Following on the direction laid out in the conclusions of last year’s Conference, the main theme of IRENEC 2014 is the global challenge of transforming the existing energy network to enable a 100% renewable energy future.

We are looking forward to the pleasure of meeting you at IRENEC 2014
Renewable Energy for Equity, Freedom, Peace and Local Employment

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We are looking forward to the pleasure of meeting you at IRENEC 2015
Transition to Ecological and Democratic Societies Using 100% Renewable Community Power

Transition of communities, islands, countries and regions to 100% Renewable Energy (RE) can be realized only by the local, national and regional governments which are on the solution side.

The green solution in the energy field is the achievement of 100% renewable energy target by the integration of the energy end-use efficiency, smart grids and storage of the renewable energy using the best available technologies.

Energy-Economy-Ecology decision making models and Internalization of Externalities are required to plan the future energy systems with the technologies of the future and to eliminate the dislocation of obsolete technologies from one market to another in our global living space.

Renewable Energy Association of Turkey (EUROSOLAR Turkey), once again brings you the annual International 100% Renewable Energy Conference (IRENEC 2016).

As per the vision of the Association, IRENEC conferences provide an international platform for the sharing of knowledge and ideas regarding the technical, economic, and political aspects of the transition to 100% Renewable Energy and for building the networks to realize this vision through industry, architecture, transportation, local communities and training.

We are looking forward to the pleasure of meeting you at IRENEC 2016.
How to Speed-up the Global Transition to 100% Renewable Energy?

Transition of communities, islands, countries and regions to 100% Renewable Energy (RE) can be realized only by the local, national and regional governments which are on the solution side.

The green solution in the energy field is the achievement of 100% renewable energy target by the integration of the energy end-use efficiency, smart grids and storage of the renewable energy using the best available technologies.

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We are looking forward to the pleasure of meeting you at IRENEC 2017.
We would like to invite the public officials, representatives of business and industrial organizations, academicians, teachers and students, NGO representatives to

IRENEC 2018
8TH INTERNATIONAL
100% RENEWABLE ENERGY CONFERENCE
on 7-10 MAY 2018
MALTEPE TÜRKEN SAYLAN CULTURAL CENTER
İSTANBUL TURKEY

TO GET INFORMED ABOUT AND TO TAKE PART IN SHAPING TURKEY’S RENEWABLE ENERGY FUTURE.

LET’S MEET TOGETHER TO

- get informed about the global and local implementations and technologic developments in the field of the renewable energy.
- to set the roadmap for the transition to renewable energy in cities and countries.
- join the workshops where we will discuss the challenges and solutions about the transition to renewable energy in our country.
- cooperate in order to adopt the conference results into real life.
- identify the roles and responsibilities of the individuals, decision makers, academic institutions, cooperatives and local authorities in the global transition to 100% renewable energy on the basis of community power principle.

RENEWABLE ENERGY ASSOCIATION

www.irenece.org • www.eurosolar.org.tr • www.powercommunities.org
Towards 100% Renewable Energy
Techniques, Costs and Regional Case-Studies
Series: Springer Proceedings in Energy

This volume collects papers presented at the International 100% Renewable Energy Conferences (IRENEC) from 2011 to 2015. Given the time span, the chapters have been updated to ensure they are timely and pertinent. These proceedings are the outcome of an international group of research scientists and experts contributing to energy solutions within their research, development, and implementation. This book is aimed at researchers and decision makers who are working on problems and issues within energy efficiency. Tables, graphs, and diagrams accompany the text promoting 100% renewable energy as a solution in solidarity with energy end-use efficiency and renewable energy storage. In this manner, Towards 100% Renewable Energy offers leaders considering the transition from fossil problems to alternative solutions new food for thought and incentives for action.
Status, Requirements and Strategic Planning for Speeding up the Global Transition to 100% Renewable Energy

IRENEC 2019
9TH INTERNATIONAL 100% RENEWABLE ENERGY CONFERENCE
24-26 APRIL 2019

Renewable Energy Revolution with Community Power requires active contribution of all stakeholders and support from Decision Makers taking part on the solution side.

No more blackouts anywhere in the world with wind, water, bio-energy, geothermal and sunlight providing stable 100% clean renewable power for the World.

All cities of the world to go to 100% Renewable Energy by 2050 for Equity, Freedom, Peace and Local Employment

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