# Green energy monitoring system (based on Eol2020 weather data logger)
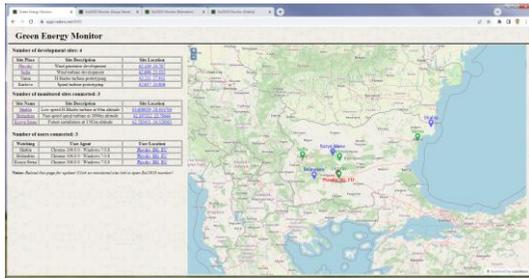
Main page with sites and users lists
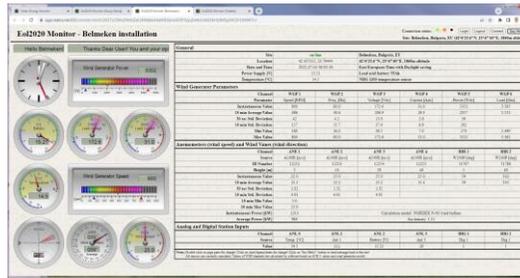
Monitoring page with data table
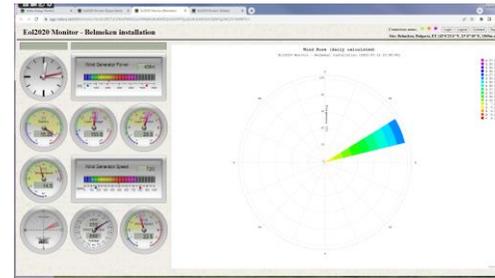
Monitor page with wind rose charts
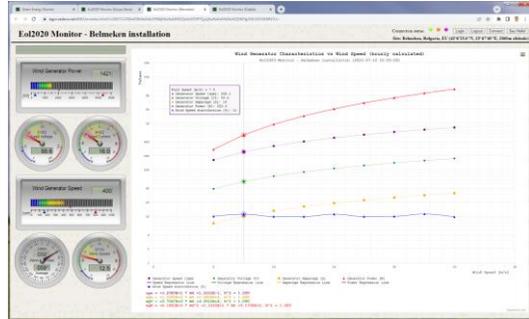
Monitor page with wind generator charts
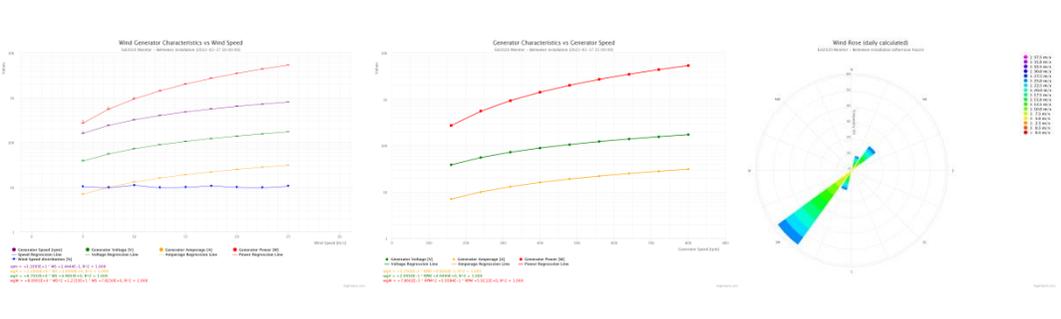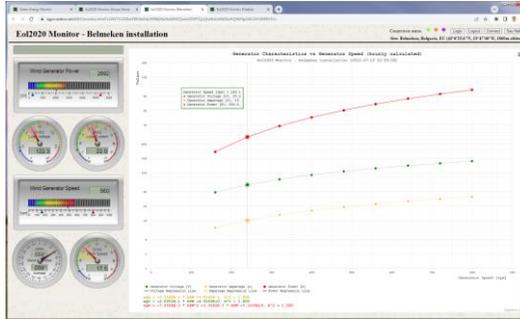
Wind generator and wind rose charts (exported to PNG files)

System staff schematics based on JavaScript, Node IPC and Web Sockets
Node JS multithreaded server and HTML 5 client applications
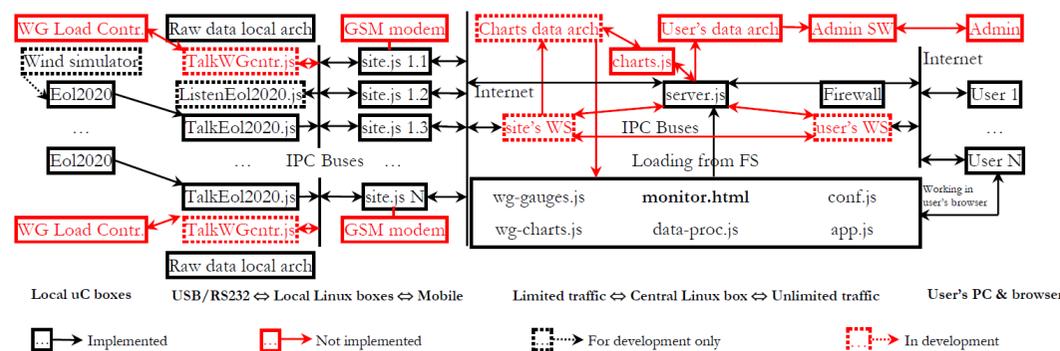
System staff screenshots
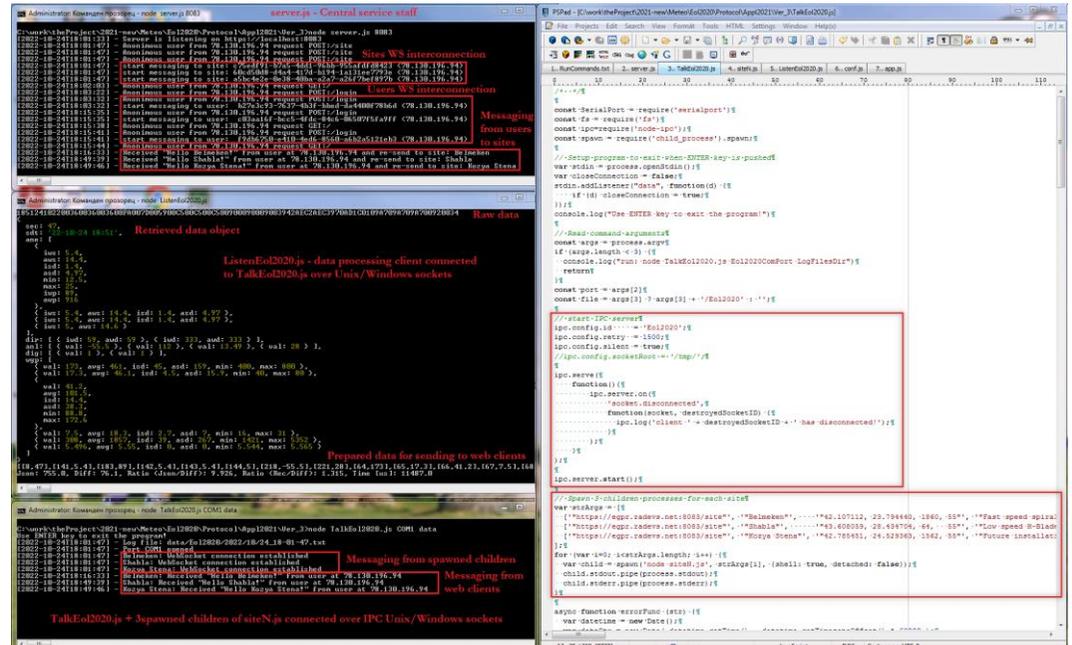
Windows console commands to run server staff (development version)

cd C:\PathToApplicationParentFolder\Appl2021\Ver_3

node server.js 8083	implements HTTPS service and and will spawn suported slave processes
node ReadLine.js COM16 COM17	monitor communications with Eol2020 via HW serial debug cable
node ListenEol2020.js	for testing only – processed Eol2020 records and generates wind rose data
node ListenFSChanges.js	processed data changes in files and generate coresponding charts
node TalkEol2020.js COM1 data	implements Eol2020 protocol and spawn siteN.js slave processes
in browser:	https://egpr.radevs.net:8083

Raw Eol2020 station data, real numbers object incl. wind generator data and corresponding data sent to web application

1705060222009600960096000FA003204E60085008500850096009600960903D02FEC2EED386F941C1300A200A200A200980098
{
  sdt: '22-02-06 17:05',
  sec: 24,
  ane: [
    { iws: 15, aws: 15, isd: 1.15, asd: 1.27, min: 5, max: 25, iwp: 1254, awp: 976 },
    { iws: 15, aws: 15, isd: 1.15, asd: 1.27 },
    { iws: 15, aws: 15, isd: 1.15, asd: 1.27 },
    { iws: 15, aws: 15.2 }
  ],
  dir: [{ iwd: 66, awd: 65 }, { iwd: 333, awd: 335 }],
  anl: [{ val: -56 }, { val: 111 }, { val: 11.54 }, { val: 28 }],
  dig: [{ val: 1 }, { val: 1 }],
  wgp: [
    { val: 480,   avg: 480,   isd: 37,   asd: 41,   min: 160, max: 800 },
    { val: 48,   avg: 48,   isd: 3.7, asd: 4.1, min: 16,   max: 80 },
    { val: 105.5, avg: 105.5, isd: 12.7, asd: 13.5, min: 38.5, max: 172.6},
    { val: 19,   avg: 19,   isd: 2.4, asd: 2.5, min: 7,   max: 31 },
    { val: 2006, avg: 2006, isd: 30,   asd: 34,   min: 270, max: 5352 },
    { val: 5.551, avg: 5.551, isd: 0,   asd: 0,   min: 5.49, max: 5.565 }
  ]
}
[[0,24],[141,15],[183,1254],[142,15],[143,15],[144,15],[64,480],[65,48],[66,105.5],[67,19],[68,2006]]

Interpolated and historical data charts candidates with mean, min/max and/or mean ± st. dev. values per point
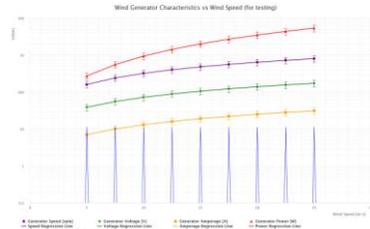
mean, min/max **OR** mean ± st. dev. vs wind speed

mean, min/max **AND** mean ± st. dev. ws rotational speed
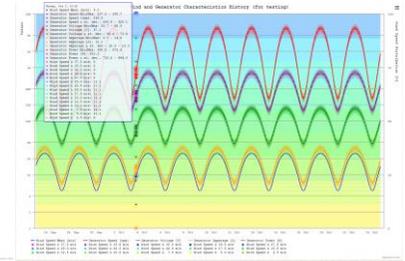
History chart model (20 parameters) for a long period of time

New protocol consists of array of table cell No / changed value pairs

All table values are sent once per minute. Compression ratios are ~1/11.5 corresponding to complete stringified object and ~1/1.5 – to raw meteo station data (50 Bps or 100 chars per second)

[[8,11],[141,13.9],[183,1158],[142,13.9],[143,13.9],[144,14.4],[64,445],[65,44.5],[66,98.2],[67,17.7],[68,1736],[69,5.548]]
[[8,13],[141,15],[183,1254],[142,15],[143,15],[144,15],[64,480],[65,48],[66,105.5],[67,19],[68,2006],[69,5.551]]
[[8,15],[146,332]]

Eol2020 original hardware and software staff

Kintech Engeneering's Eol2020 data loger (obsolete model)

Eol2020 SW – realtime monitor
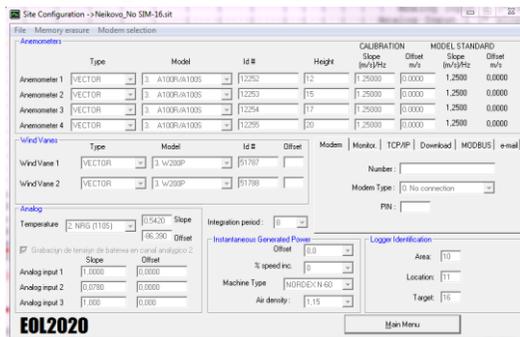
Eol2020 SW – configuration editor

Weather, solar sensors and power supply

Eol2020 protocol analyzing and established record's data meaning (data record send by station – 100 symbols, 50 hex bytes)

Anemometer 1, 2, 3 and 4 (on Digital input 1) are connected to Arduino Leonardo as wind speed simulator (slope 1.25 (m/s)/Hz) generating 4-20 Hz 50% PWM (5-25 m/s wind speed).
Analog input 1 and 3 are connected to potentiometers set to 1.56 and 0.97V respectively (slope=1). Analog input 2 connected internally to the battery (slope=0.078).
Wind Vane 2 (DIR 2) is connected to potentiometer set to 1.71V. All other sensors are set but not connected.
Additional 20 symbols of data are sending by station at the beginning of the first record (unusable).
Station time and date is 3:43 on 3.11.2021.

```
                                                              Average Std. Deviation Anemometer 1 [m/s] (sq. root / 10)
                                                              |    Average Std. Deviation Anemometer 2 [m/s] (sq. root / 10)
                                                              |    |    Average Std. Deviation Anemometer 3 [m/s] (sq. root / 10)
                                                              |    |    |    Average Wind Speed Anemometer 4 [m/s] (could be WG speed)
                                                              |    |    |    |    Inst. Wind Speed Anemometer 4 [m/s] (could be WG speed)
Discovered record's parts:                 Probably data for digital ports   |    |    |    |    |
03 43 03 11 21 007D 007D 007D 007D 007D 03ED 0000 0000 0000 007D 007D 007D 03EE EC 56 ED 56 3A D6 9A 69 01 0000 0000 0000 007D 007F
|  |  |  |  |   |    |    |    |    |    |    |    |    |    |    |    |    |   ??
|  |  |  |  |   |    |    |    |    |    |    |    |    |    |    |    |    |   |  Analog Input 3 (* slope + offset, could be WG current)
|  |  |  |  |   |    |    |    |    |    |    |    |    |    |    |    |    |   Analog Input 2 (* slope + offset, could be battery)
|  |  |  |  |   |    |    |    |    |    |    |    |    |    |    |    |    Analog Input 1 (* slope + offset, could be WG voltage)
|  |  |  |  |   |    |    |    |    |    |    |    |    |    |    |    Temperature (* slope + offset)
|  |  |  |  |   |    |    |    |    |    |    |    |    |    |    Average Wind Direction 2 [degree] (+ offset)
|  |  |  |  |   |    |    |    |    |    |    |    |    |    Average Wind Direction 1 [degree] (+ offset)
|  |  |  |  |   |    |    |    |    |    |    |    |    Instantaneous Wind Direction 2 [degree] (+ offset)
|  |  |  |  |   |    |    |    |    |    |    |    Instantaneous Wind Direction 1 [degree] (+ offset)
|  |  |  |  |   |    |    |    |    |    |    Average Wind Power based on Anemometer 1 [kW]
|  |  |  |  |   |    |    |    |    |    Average Wind Speed Anemometer 3 [m/s]
|  |  |  |  |   |    |    |    |    Average Wind Speed Anemometer 2 [m/s]
|  |  |  |  |   |    |    |    Average Wind Speed Anemometer 1 [m/s]
|  |  |  |  |   |    |    Std. Deviation in 30 sec Anemometer 3 [m/s] (sq. root / 10)
|  |  |  |  |   |    Std. Deviation in 30 sec Anemometer 2 [m/s] (sq. root / 10)
|  |  |  |  |   Std. Deviation in 30 sec Anemometer 1 [m/s] (sq. root / 10)
|  |  |  |  Instantaneous Wind Power based on Anemometer 1 [kW]
|  |  |  Min Wind Speed Anemometer 1 [m/s]
|  |  |  Max Wind Speed Anemometer 1 [m/s]
|  |  Instantaneous Wind Speed Anemometer 3 [m/s]
|  |  Instantaneous Wind Speed Anemometer 2 [m/s]
|  Instantaneous Wind Speed Anemometer 1 [m/s]
|  Date's Year (the last 2 digits after 2000)
|  Date's Month            ← Without hex to
|  Date's Day              decimal conversion
|  Time Minute
Time Hour (24 hour format)
```

Simple HW cable for protocol analyzing

Note: Use Female DB9 connectors, DB9 M/F 1:1 serial cables and FTDI USB to Dual RS232 or similar adapter. Flow control signals can be cross connected as well

Data volumes

Base	rec	min	hour	day	week	month	year
100 bytes ASCII data (as from Eol2020)	100	2,7kB	164,1kB	3,8MB	26,9MB	115,4MB	1,4GB
50 bytes binary data (as from Eol2020)	50	1,4kB	82kB	1,9MB	13,5MB	57,7MB	0,7GB
JSON object (all data as from Eol2020)	467	12,8kB	766,2kB	18MB	125,7MB	538,7MB	6,4GB
JSON object (instantaneous data – 2sec)	315	8,6kB	516,8kB	12,1MB	84,8MB	363,4MB	4,3GB
JSON object (average data – 1 min)	325	325B	19kB	457kB	3199,2kB	13,4MB	162,3MB
JSON object (average data – 10 min)	325		1,9kB	45,7kB	319,9kB	1,3MB	16,3MB

Notes: Data volumes at JSON object can be lowred if zero values are omited

Interconnection schematics for protocol analyzing with simple HW cable and Eol2020 program development

Complex TCP client/server scenario using special HW cable, FTDI adapter, SW com0com cable, hub4com, com2tcp for receiving a copy over Internet of Eol2020 data proceed by JS SW simulator TalkEol2020.js & ListenEol2020.js (preliminary development staff and scenarios)

Main components at local site in action

Main components on both sites in action

```
host: +CRING; VOICE (len=14)
host: +CLIP: "2111021653",161,,,"Direct COM" (len=39)
host: +CRING; VOICE (len=14)
host: +CLIP: "2111021653",161,,,"Direct COM" (len=39)    ← With this message sequence is requested a new connection (timeout is required)!
host: +CRING; VOICE (len=14)
host: +CLIP: "2111021653",161,,,"Direct COM" (len=39)
stat: ata (len=4)                                          ← With this message sequence is starting a new connection!
host: CONNECT 9600 EMUL (len=18)
stat: IN (len=3)
host: MONIMONIMONI (len=13)    ← Message sequence for requesting and receiving the first data record after starting a new connection!
stat: 001011169C##006E1D1F16530211210070007D007B03ED000000000000007D007D03EEEC56EC563AD29C6801000000000000002002 (len=121)
stat: IN (len=3)                                           ← Message sequence for requesting and receiving any next data record (timeout is required)!
host: MONIMONIMONI (len=13)
stat: 16530211210070007D007D007E00/B03E000000000000007D007D03EEED57EC563AD29C6801000000000000002002 (len=101)
host: +++ (len=4)                                          ← This message from host software stops monitoring and should be sent after stat: IN!
stat: IN (len=3)
host: OK (len=3)
stat: IN (len=3)                                           ← After that message Eol22020 station can be contacted after a long period of time!
stat: ++++++++ATH (len=13)
```

Communication records between Eol2020 and its Windows SW at starting monitoring mode

Windows console commands to run server staff

For local SW analyzer cable run:	hub4com.exe --baud=9600 --octs=off --no-default-fc-route=All:All --route=0:1,2 --route=1:0,3 \\.\COM1 \\.\CNCA0 \\.\CNCA1 \\.\CNCA2
run protocol analyzer:	node ReadLine.js COM91 COM92 file 1
connect:	Eol2020 station to real RS232 COM1 port using DB9 F/F serial cable with 1:1 wires
run:	Eol2020 software and set it for serial connection to COM4
On local site run test program:	node TalkEol2020.js COM1 CNCA0 yyy
COM to TCP port hub:	hub4com.exe --baud=9600 --octs=off --no-default-fc-route=All:All --route=0:1,2 \\.\COM4 \\.\CNCA1 --use-driver=tcp *10020
HW cable analyzer:	node ReadLine.js COM16 COM17 – 1
PuTTY terminal on:	COM91 (output from TalkEol2020.js)
forward router port:	egpr.radevs.net:10020 to i7/W7 PC:10020
On local site run for testing:	like at remote site
com2tcp redirector:	com2tcp.exe \\.\CNCA2 egpr.radevs.net 10020
PuTTY terminal on:	COM92 (the stream after com2tcp redirector)
On remote site run client:	com2tcp.exe \\.\CNCA2 egpr.radevs.net 10020
and test program:	node ListenEol2020.js COM91

Notes:
com0com setup is the same on both local and remote computes;
com0com pairs: CNCA0 ↔ COM4, CNCA1 ↔ COM91, CNCA2 ↔ COM92, CNCA3 ↔ COM5, CNCA4 ↔ COM90 (opt.);
Real RS232 COM port is required only for local computer to connect Eol2020;
Simple HW protocol analyzer cable incl. dual RS232 / USB FTDI adapter is optional (com0com based SW analog could be used);
TalkEol2020.js implements station serial protocol and ListenEol2020.js implements station record processing
Testing programs TalkEol2020.js and ListenEol2020.js can be pipelined using their Input / Output COM ports and com0com staff.

```
//·Comands·to·send·to·Eok2020·for·date·and·time·setup¶
//·Single·byte·values·should·be·converted·to·a·character¶
//·Each·character·has·to·be·doubled·and·added·to·the·command¶
//·At·the·end·of·"GRABA00kk"·command·'11'·should·be·added¶
var·commandsDateTime·=·["MONIMONIMONI",¶
·······················"MONIMONIMONI",¶
·······················"GRABA00gg",·//·set·minutes¶
·······················"GRABA00ff",·//·set·hours¶
·······················"GRABA00jj",·//·set·year¶
·······················"GRABA00ii",·//·set·month¶
·······················"GRABA00hh",·//·set·day¶
·······················"GRABA22",··//·dayOfYear·>·255·?·'\x1E'·:·'\x0E¶
·······················"GRABA00kk",·//·String.fromCharCode(dayOfYear·#·256)¶
·······················"MONIMONIMONI"¶
·······················]¶
```